IDENTIFICATION OF COSTS TO STATES TO PERFORM CERTAIN MARINE ENVIRONMENTAL PROTECTION FUNCTIONS

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THESIS

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by

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• Other considerations relating to state assumption of marine environmental protection functions are outlined. A grant-in-aid program may be established by the Coast Guard to induce state participation. A possible fund allocation formula is presented. It is based on maintaining the present level of cost-effectiveness for the program

Identification of Costs to States to Perform Certain Marine Environmental Protection Functions

by

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I. INTRODUCTION AND BACKGROUND

"Decision making involves weighing the advantages or 'benefits' of a potential action against its disadvantages or 'costs'." [20,p.93] The objective of this study is to attempt to identify the costs involved in one possible course of action that the U.S. Coast Guard may pursue in connection with its Marine Environmental Protection (MEP) program. Potential benefits of that course of action can be weighed against the costs identified herein to provide a basis for decision making.

The course of action considered is the possible devolution of two MEP functions from the Coast Guard to the states. These functions are (1) pollution incident cleanup and (2) pollution incident investigation for legal action.

The U.S. Coast Guard has "concluded that the incentive needed to encourage this participation by states is economic aid in the form of grants." [6,p.1] Prior to initiation of a grant program, the potential size of such a program must be determined; and an appropriate formula or criterion for fund allocation to the states must also be determined.

The first step is the estimation of the explicit costs of performing the functions outlined above. Such costs as that of purchasing, stockpiling, and maintaining pollution response equipment, training and employing personnel, and conduction and processing pollution incident response investigations are to be considered.

With those data, it may then be possible to predict the overall size of the program. Further, the costs may show some direct relationship to causal factors. These factors could then provide a basis for a fund allocation formula.

A. U. S. COAST GUARD MEP RESPONSIBILITIES

Why should the Coast Guard desire that a project of this nature be undertaken? The Coast Guard has long been the primary federal maritime law enforcement agency. In that role, the Coast Guard has always participated in the enforcement of anti-pollution legislation such as the Refuse Act of 1899, the Oil Pollution Act of 1924, and the Oil Pollution Act of 1961.

Events occurring in the late 1960's acted to give impetus to the existing programs and to development of new federal legislation. Specifically, pertinent events included the following:

1. The tanker Torrey Canyon grounded off the English coast on March 18, 1967 and caused one of the largest oil spills in history.

2. A gas blowout on an offshore oil platform in the Santa Barbara channel on January 28, 1969 resulted in oil seepage for over a week.

3. The National Environmental Policy Act, which became law on June 1, 1970, created the President's Council on Environmental Quality. This was among the first of the major pieces of environmental legislation in response to the

increased public and political concern with the protection of the environment.

4. The Water Quality Improvement Act, which became law on April 3, 1970, provided for civil penalties and cleanup of oil spills.

5. The collision of two Standard Oil Company tankers in San Francisco Bay on April 22, 1970 resulted in a 20,000 barrel[1] oil spill.

6. The Port and Waterways Safety Act became law on July 10, 1972. It authorized the regulation of ship traffic and ship construction to provide increased environmental protection.

7. The amendments to the Federal Water Pollution Control Act became law on October 18, 1972 and expanded the provisions of the Water Quality Improvement Act.

The significance of the events listed above to the Coast Guard can be demonstrated by their effect on the Coast Guard budget. In fiscal year 1969, the Marine Environmental Protection program budget stood at $3,570,000. By fiscal year 1974, the MEP budget had increased to $22,013,000. During the same period, personnel assigned to this program increased by 518.

There are two main pieces of legislation requiring active Coast Guard roles in the protection of the environment that

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[1] One barrel of oil equals 42 U.S. gallons, 6.5 barrels of oil equals approximately one ton.

are pertinent to this project. These laws and the Coast Guard functions under each are as follows:

1. The Federal Water Pollution Control Act, as amended [53,p.18]

a. "Engage in such research, studies, experiments relative to the removal of oil from any waters and to the prevention, control, and elimination of oil and hazardous substances pollution." (The law did not specify what was to be considered a hazardous substance. The Environmental Protection Agency was to designate those substances, and it has not yet done so.)

b. Receive notifications of discharges from vessels and from onshore and offshore facilities in accordance with Section 311(b)(5).

c. Assess civil penalties of not more than $5000 for each offense against the "owner or operator of any vessel, onshore facility, or offshore facility from which oil or a hazardous substance is discharged."

d. "Act to remove or arrange for the removal of such oil substance at any time, unless determined such removal will be done properly by the owner or operator of the vessel, onshore facility, or offshore facility from which the discharge occurs."

e. Establish a National Strike Force of personnel "trained, prepared, and available" to act "to minimize damage from oil and hazardous substance discharges, including containment, dispersal and removal of oil and hazardous substances."

f. Issue regulations pertaining to (1) methods and procedures for removal of discharged oil and (2) procedures, methods and equipment to prevent discharges from vessels and facilities.

g. Assess civil penalties for violations or regulations.

h. Administer a $35 million Revolving Fund to affect cleanup of spills when the spiller does not take the necessary action or when the spiller is not known. The Coast Guard contracts for cleanup and later attempts to recover the costs of cleanup from the spiller.

i. Conduct investigations as necessary to enforce the provisions of section 311.

j. Deny entry to ports or detain at the port any vessel over 300 gross tons, except non-self propelled barges not carrying oil or hazardous substances as cargo or fuel, that does not produce evidence of financial responsibility as defined in section 311(p)(1).

k. Provide the On-Scene-Coordinator to direct spill response activities in coastal waters, Great Lakes waters, ports and harbors.

2. The Port and Waterways Safety Act of 1972. [53,p.20]

a. Issue regulations for vessel safety for vessels carrying certain cargoes in bulk.

b. Issue regulations to prevent pollution of the marine environment resulting from vessel or structural damage or loss.

c. Set requirements for shipping documents and for tankerman and officer certification.

d. Investigate any accident, incident, or act involving the loss of, destruction of, or damage to any structure subject to Title I of the Act.

e. Assess penalties for violations of regulations issued pursuant to the Act.

f. Deny entry to U.S. waters to vessels not in compliance with rules and regulations issued under Title II of the Act.

The above listing was not intended to be an exhaustive list of U.S. Coast Guard responsibilities, even under the specified legislations. It was intended to provide a legal and functional framework to define the factors that are pertinent to this study.

A significant factor concering the above listed Coast Guard MEP activities is that the resources budgeted for fiscal year 1975 "should allow the MEP program to meet 50% of its standards of program effectiveness." [53,p.5] A contributing factor to the lack of Coast Guard ability to meet

these standards fully is a recently broadened definition of what constitute waters of the United States.

> In our view, this comprehends the entire riverine system within the United States extending upstream to the sources, whatever and wherever they maybe. This view takes into account nearly all of the water bodies that exist in this country. 54,p.2-6

This vast water area is one reason why the Coast Guard is interested in the possibility of increased participation by the states in MEP activities. A second and equally compelling reason lies in the administration's policy of "new Federalism."

B. NEW FEDERALISM BACKGROUND

In the 1975 fiscal year Policy Guidance issued by the Office of Management and Budget (OMB),

> The Coast Guard has been directed to re-examine the federal role in Marine Environmental Protection, in the context of the administration's policy of new Federalism, and report to OMB recommending appropriate roles for state and local governments in this program, together with suggested incentives to prepare them to assume those roles. [ref.57]

The OMB policy Guidance and the subsequent Coast Guard report represent the essential background for the research involved in this study. To understand the new federalism concept, the basic administration objectives should be reviewed. These basic objectives include the following that pertain to this study: [ref.27]

1. The basic administration philosophy is that "Government in the United States is too large and too powerful and must be reduced. There should be greater opportunity for the American people to make for themselves choices about what is best for them."

2. "Governmental functions should be provided by those levels best able and willing to serve the needs of the people." This involves determining which program activities might be performed by state and local governments without loss of effectiveness.

3. There should be a "decentralization and streamlining of federal programs."

4. "State and local elected officials should, to the maximum extent possible, have responsibility for administration and management of federally assisted programs within their respective jurisdictions."

5. "Federal, state, and local governments should cooperate in developing the necessary management planning and evaluation skills that will enable all levels of government to manage more effectively and efficiently."

6. "The federal government should create the proper climate for involvement of the private sector in generating ideas and resources to achieve solutions."

It would be well to keep those basic objectives in mind throughout the remainder of this paper. Results that are not in keeping with these objectives are unacceptable.

In response to OMB Policy Guidance, and in keeping with the objectives of new federalism, the Coast Guard determined that there existed a possibility for grants-in-aid to states to perform certain Marine Environmental Protection functions. The problem of determining what incentives would be necessary to induce the desired state participation is the complication. What incentives will be necessary is a function of two types of factors: cost factors and political factors.

MEP activities cost money. To have states assume additional environmental protection activities will affect budgetary allocations. But, money is not the only significant factor. State governments exist in a political

environment. There are, therefore, political factors determining when, what, or how much of the state resources are to be devoted to any activity. Political factors for states include the following:

1. Existing state environmental protection laws.
2. Priority placed on environmental protection.
    a. Amount of state waters affects this.
    b. Amount of commercial, recreational, and other activity on or along those waters is important.
3. Existing state environmental protection agencies.
4. Past experience with federal grants-in-aid.

These political factors can all affect the incentives that would be necessary to induce state participation. Past experience with federal grants-in-aid may not be as important as the other factors, but it may be the marginal factor in deciding the success of the overall program.

Under President Nixon, federalism became a basic objective in many of the administration's domestic programs. Recent federal actions in keeping with the new federalism concept are: [70,p.6]

1. The General Revenue Sharing Program.
2. The Law Enforcement Assistance Program.
3. The Comprehensive Employment and Training Act.
4. The Rural Development Act.
5. The Small Boat Safety Act.

The last mentioned is the most widespread venture into the use of grants-in-aid in which the Coast Guard has been

involved. It has been proposed that the Boating Safety Program might be representative of an approach that could be used to encourage state activity in the MEP field. [70,p.8]

Some of the provisions of the Boating Safety program that may be apllicable to the MEP program include the following: [70,p.9]

1. The Coast Guard approves state programs directed at implementing and supplementing the Act. This approval determines whether the state is to receive the full grant or a partial grant.

2. State programs would provide for administrative services (numbering of boats, maintaining records, and submitting reports) and operational activities (patrols, inspections, and training or public education).

3. The Coast Guard encourages state effort beyond the Act.

4. The Coast Guard has the authority to terminate payments if unauthorized and unacceptable changes in a state's program occur.

5. The grant allocation formula provides for federal shares of total annual cost not to exceed these limits:

a. 75% in fiscal year 1972.
b. 66 2/3% in fiscal year 1973.
c. 50% in fiscal year 1974.
d. 40% in fiscal year 1975.
e. 33 1/3% in fiscal year 1976[2].
f. No state may receive more than 5% of the available federal funds.

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[2]It is now envisioned that the federal grant will be continued at a 50% level.

Thus, the Boating Safety Act and the resultant programs provide for the Coast Guard to establish administrative guidelines and allocate funds according to the above formula to those states meeting the guidelines. Obviously, the intent is for states gradually to assume a greater portion of the program financing. This may not be the case with a MEP grant program. The administrative aspects of the grant should be similar, though; and, for the purpose of this study, they will be assumed to be virtually identical.

One potentially significant difference between the Boating Safety program and a Marine Environmental Protection program is that the Boating Safety program is a revenue-generating program at the state level. The licensing and numbering activities provide revenues to defray the impact of the program on the state budget. No such revenue-generating capacity exists within the MEP activities presently contemplated for state assumption. The allocation formulas may not be similar, and a reduction in federal share of funding may not be possible.

C. EXPLICIT SUB-OBJECTIVES OF THIS STUDY

The costs of MEP activities will be determined through the analysis of data obtained from local Coast Guard units, Coast Guard District Offices and other documentary sources. The data analysis should (1) show underlying relationships between the factors pertinent to MEP, (2) provide a basis for isolating the Coast Guard activities relative to each

specific MEP function, and (3) allow an estimation of the costs of each specific function.

The data analysis will then establish a cost for MEP activities at the level of performance of those activities in the 11th, 12th, and 13th Coast Guard Districts; those are the areas to which this study will be confined. The cost will be a basis from which the costs of state assumption of MEP functions can be addressed.

The potential differences between a state organization and the Coast Guard MEP organization will be discussed. The potential difficulties with state assumption of MEP functions will be discussed. Possible considerations in grant allocations will also be mentioned.

Finally, the study will provide a list of recommendations and conclusions based on the data analyses and the state MEP organization adminstrative considerations. Areas in which the available information is inadequate or inconsistent will be identified. This may proved an impetus to further study in these and other related areas.

II. DATA GATHERING PROCEDURES

The primary means of gathering information for this project were personal visits to Coast Guard District Offices and operational units. Information was gathered from the following areas:

1. The 11th Coast Guard District Office and units in that district.

   a. San Diego Captain of the Port Office.

   b. Los Angeles/Long Beach Captain of the Port Office.

2. The 12th Coast Guard District Office and units in that district.

   a. San Francisco Captain of the Port Office.

   b. Concord Port Safety Station.

   c. Monterey Captain of the Port Office.

   d. Humboldt Bay Captain of the Port Office.

3. The 13th Coast Guard District Office and units in that district.

   a. Seattle Captain of the Port Office.

   b. Portland Captain of the Port Office.

Captain of the Port personnel are the operational arm of the Coast Guard in local pollution incident response, investigation and prevention activities.

Although interviews were conducted, these visits were mainly for the purpose of examining local records. From these records, available information on the following topics

was obtained:

1. Specific costs of pollution cleanup efforts.

2. Causes of pollution incidents.

3. Typical response actions to pollution incidents.

4. District Office and local unit organization for MEP activity.

5. Lists of petroleum-handling waterfront facilities.

6. Manhours spent in investigation, cleanup, MEP administration and support.

7. Physical resources used in investigation, cleanup, MEP administration and support.

Information was obtained from state agencies now performing MEP functions. These agencies were questioned concerning their present level of activity, their organization, and the costs incurred in performing their present activities. Agencies contacted included the following:

1. Department of Ecology, State of Washington.

2. Department of Environmental Quality, State of Oregon.

3. Department of Fish and Game, State of California.

4. Department of Fish and Game, State of Nevada.

Finally, information was obtained from commercial firms and cooperatives engaged in providing cleanup services in major harbors on the West Coast. These companies do maintain cleanup equipment, do operate that equipment, and do train personnel. Thus, financial information and price lists from these companies can provide some guide to potential costs of MEP activities to a state. Information was obtained

from the following private enterprises:

1. Clean Sound, Seattle, Washington.
2. Western-Willamette Corp., Portland, Oregon.
3. Clean Bays, Concord, California.
4. Clean Seas, Santa Barbara, California.
5. Marine Oil Pickup Service, Seattle, Washington.
6. Oil Spill Services, Kirkland, Washington.
7. Crosby and Overton, Inc., Long Beach, California
8. Wm. H. Hutchinson and Sons, Wilmington, California.

In addition to direct information from these organizations, many pieces of documentary information were examined. Legal documents were reviewed. These include federal laws, federal regulations, and intra-agency directives concerning criteria for and standards of performance for marine environmental protection. Existing state laws were reviewed. Inventory lists, price lists and financial statements of commerical firms were reviewed.

Statistics and data pertinent to the subject were also analyzed. Coast Guard reports provided much of the necessary data.

1. The Port Safety/Marine Environmental Protection Activities Reports provided

    a. Organizational information.
    b. Physical resources used in the MEP activities,
    c. Manhours expended in MEP related activities,
    d. Number of incidents and responses, and
    e. Amounts of petroleum transported over waters

in each jurisdiction.

2. Reports obtained from the Coast Guard Pollution Incident Reporting System provided costs and resources used in cleanup and investigation activities.

The district office and local unit personnel assisted in the interpretation of the data. Other statistics examined included shipping and marine commerce data for West Coast ports. These included statistics on ship traffic, waterfront facilities and offshore facilities. These statistics were examined in an attempt to determine the relationship of spill numbers and sizes to the level of commercial activity in the marine environment.

III. DATA ANALYSIS

Information was compiled on the following variables pertinent to this study. These variables will be referred to hereinafter by the numbers in the listing below.

1. Number of barrels of oil transferred per quarter in port areas for which Coast Guard units have responsibility (Tables B33 and 34).[3]

2. The number of tank vessels transitting areas for which Coast Guard units have responsibility per quarter (Table B6).

3. The number of waterfront facilities in each area that have filed letters of intent to engage in the transfer of petroleum to vessels with capacities of 350 barrels or more for that petroleum (Tables A1-A7).

4. The number of pollution incident cleanup operations in which Coast Guard personnel participated (Tables B13 and 14).

5. The man-hours expended by Coast Gaurd personnel in cleanup operations (Tables B13 and 14).

6. The number of spill investigations performed within each Coast Guard unit's area of responsibility per

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[3]Tables with alphabetic prefixes are located in the corresponding appendix. Some of the exhibits are tables and referred to as tables. The table number listed is then the exhibit number.

quarter (Tables B11 and 12). All spills reported are investigated. Hence, the number of investigations is equal to the number of known spills.

7. The amount of oil spilled, measured in barrels, in each Coast Guard unit's area, per quarter (Table B3).

8. The man-hours expended each quarter in spill investigation in each area (Tables B11 and 12).

9. The man-hours expended in administrative activities related to MEP functions at Coast Guard units in each area (Table B14).

10. The man-hours expended in activities in support of MEP functions at Coast Guard units in each area (Table B15).

11. The hours of Coast Guard vehicle use in investigative activities, per quarter, in each area (Tables B11 and 12).

12. The hours of Coast Guard boat use in investigative activities, per quarter, in each area (Tables B11 and B12).

13. The hours of Coast Guard vehicle use in cleanup operations, per quarter, in each area (Tables B13 and 14).

14. The hours of Coast Guard boat use in cleanup operations, per quarter, in each area (Tables B13 and 14).

15. The number of spill cleanup operations in each area performed by any party, per quarter (Table B7).

16. The number of spill cleanup operations that the Coast Guard has funded from the federal Revolving Fund for 1971, 1972 and 1973, by Coast Guard District (limited to

the.11th, 12th and 13th Districts) (Tables B8-B10).

17. The net amount paid by the Coast Guard to commercial contractors for cleanup operations. (Net amount is the total expenditure, less the amount that the Revolving Fund has been reimbursed by spillers.) (Tables B8-B10).

A. SOURCES OF DATA

Sources used in the compilation of the data are as follows:

1. The U. S. Coast Guard Port Safety/Marine Environmental Protection Activities Reports for the 11th, 12th and 13th Coast Guard Districts provided data on the following (as shown in tables in appendices A and B)

a. Oil volume transferred;

b. Cleanups and Coast Guard personnel man-hours expended in cleanups in which Coast Guard personnel participated:

c. Number of spills;

d. Volume of oil spilled;

e. Man-hours expended by Coast Guard personnel in investigation;

f. Man-hours expended by Coast Guard personnel in MEP administrative activities;

g. Man-hours expended by Coast Guard personnel in MEP support activities;

h. The number of cleanup operations performed by any party;

i. The hours of vehicle and boat use involved in the above activities.

Data reported by local units were combined and totalled by Captain of the Port and Port Safety Station areas of responsibility. Thus, the data are presented according to eight areas: Seattle, Portland, Concord, San Francisco, Monterey, Humboldt Bay, Los Angles/Long Beach and San Diego. Exhibit B1 shows these areas on a map.

2. The U. S. Army Corps of Engineers' Waterborne Commerce provided the following data as shown in Tables B4 and B6: ref. 15

a. Tank vessel transits were compiled by area. Every effort was made to eliminate double-counting of transits. Arrivals and departures were counted for each port area, but not for connecting waterways. Quarterly transit data were not readily available; the transit figures per quarter were established by summing the annual transits for 1970 through 1973, and converting to a quarterly average.

b. Petroleum transportation volumes were compiled by each port along the West Coast for 1971 and 1972. These indicate potential areas of pollution incident occurrence.

3. Coast Guard District Office and local unit records provided spill data, including the number of spills cleaned up by the Coast Guard for 1971, 1962 and 1963, Revolving Fund expenditures for those years are shown in Tables B8, B9, and B10.

4. Additional cost and equipment information was obtained from the Batelle-Northwest Study (Tables and B19 and B20, and from commercial firms' price lists.

5. Information regarding number and location of waterfront facilities which have submitted letters of intent to handle petroleum products was provided by Offices of the Captain of the Port. These lists are included in Appendix A.

B. DATA ANALYSES AND COMPUTATIONS

Data manipulation, including regression and correlation analyses, were performed using the SNAP/IEDA statistical computing package on the Naval Postgraduate School's IBM 360 computer. These analyses provided some interesting results, outlined as follows:

1. Means, standard deviations and ranges were computed for variables (1) to (10) for each CG unit, each quarter, and for all the units during all three quarters (Quarter 4, 1973, and Quarters 1 and 2, 1974), and are included in Tables B21 to B30.

2. Regression and correlation analyses were performed with various combinations of the first ten variables.

a. Variables 1 (petroleum transported), 2 (vessel transits), and 3 (number of facilities) were regressed against the number of spills occurring in each of the eight areas of Coast Guard unit responsiblility. It was found that a simple linear fit regressing variables 2 and 3 against variable 6 (number of spills) explained 89.5% of the

variation in the relative number of spills occurring in each area.

b. Regressing variables 1, 2, and 3 against variable 4 (number of cleanups in which Coast Guard personnel participated) shows that the first three variables explain 72.5% of the variation in variable 4. Thus, they are reasonably good predictors of the number of spills which will require Coast Guard participation in cleanup. Approximately 1.5% of all spills require Coast Guard participation.

c. Examination of the data showed that Los Angeles/Long Beach and Concord data were sometimes inconsistent with data from the other areas. Their reports were prepared using somewhat different interpretations of the preparation instructions, especially concerning man-hours expended on various activities. These reports provided useful information, as will be discussed later. Further aggregate analyses were made, however, after removing the six sets of observations from those two areas.

d. Linear regression of Variable 6 (number of spills) against Variable 8 (hours of investigation) understandably showed the former to be a good predictor of the latter, explaining 74.6% of the variation.

e. No such relationship existed between spills and hours spent on cleanup (Variable 5).

f. Excluding data from the Los Angeles/Long Beach and Concord areas, regression of Variable 3

(petroleum-handling facilities) against Variable 6 provided an equation that explained 89.5% of the variation in Variable 6. Although this result was not used in the cost analysis, the result is potentially important. It demonstrates a strong association.

g. Variable 6 also proved to be directly related to the number of both administrative and support man-hours (variable 9 and 10, respectively).

3. An average of 2.26 hours of Coast Guard vehicle use and .18 hours of Coast Guard boat use was required for each spill investigation.

4. An average of 17.6 hours of Coast Guard vehicle use, .29 hours of Coast Guard boat use and 66.36 hours of personnel time were involved in each cleanup in which the Coast Guard participated.

5. Since 1972, the Revolving Fund has been used to pay for cleaning up 2% of all reported spills, nationwide. The number of spills cleaned up has been increasing each year and averaged 5% of all reported spills during 1973 in the 11th, 12th and 13th Districts, as shown in Tables B8, B9, and B10.

6. None of the variables considered were found to be significantly related to Variable 7 (volume of oil spilled in each area per quarter).

7. Net Revolving Fund expenditures since 1971 have totalled $9,866,993. Seventy-five per cent of the cases involved outlays of less than $5,000. [54,p.2-5]

8. Excluding the Oakland Estuary spill, where over $1,000,000 was expended, the average expenditure from the Revolving Fund for cleanups in the 11th, 12th and 13th Coast Guard Districts has been $2,321 per cleaup, broken down as follows:

a. 11th District: 31 cleanups and $2,715 average outlay.

b. 12th District: 48 cleanups and $3,370 average outlay.

c. 13th District: 66 cleanups and $1,375 average outlay.

9. Table B18 shows costs of selected spills cleaned up under Coast Guard contracts. The average cost was $6,397. Labor costs represented 49.5% of the total, while equipment costs represented 50.5%.

10. An average of 232 spills were cleaned up by any party each quarter, a total of 915 spills, as shown by a comparison of Tables B4 and B11. That comparison indicates an average cleanup rate of 25% of reported spills. Since 5% are cleaned up with federal funds, 20% are being removed by spillers.

11. Man-hours of investigation reported for the Coast Guard units in Los Angeles/Long Beach and Concord included personnel stand-by hours. Estimating actual investigation man-hours by the regression equation found significant for the other six areas showed that 15% of the reported hours could be expected actually to be spent on investigatory

tasks. Thus, 85% of the hours reported for those two units were assumed to be hours spent in stand-by for spill investigation.

The data analysis results presented above are potentially significant. The number of spills in any single area is directly related to the number of petroleum handling facilities in that area. The number of spills is also directly related to and strongly associated with the average number of tank vessel transits of an area in a quarter. There was also an association between the number of spills and the amount of petroleum transferred in an area each quarter, but that relationship did not exhibit nearly the explanatory power of the other two relationships.

This analysis indicates, for the West Coast at least, that the number of petroleum handling facilities predicts the number of spills occurrring in an area, relative to the number of spills occurring in any other area. The inclusion of tank vessel transits in the analysis produces a regression equation that is significant at the .025 level. This is supported intuitively. Spills occur most often during coupling and uncoupling, when the human element enters the process. The number of facilities and the number of vessel transits provide an indication of the number of times that the human element enters the process.

It is unfortunate, but also potentially significant, that none of the variables exhibited any predictive power for the volume of oil spilled in any area during a quarter. Other

studies have found that spill volumes are almost normally distributed, but skewed to the right with a long right tail. [72,p.12]

Understandably, then, the variables considered did not exhibit strong predictive power for the number of man-hours expended on those cleanups in which the Coast Guard participated. These hours should relate to individual spill sizes, and those data were not readily available. The mean number of man-hours per cleanup in the data was used as a point estimator of actual man-hours per cleanup. Although it may not be an efficient estimator because of its large standard deviation, it was the best estimator available.

IV. COST ESTIMATIONS BASED ON DATA ANALYSIS

The cost of investigation and cleanup of pollution incidents will now be estimated by use of the relationships established through the data analysis described in the preceeding chapter. All the factors involved in the costs of these two activities will be considered in arriving at an estimate of the total cost of each of these MEP activities in each of the eight port areas (per quarter). These two activities will be considered separately, although there are potential inter-relationships. This study will refer to variables by the computer notation: X(n), where n designates the variable number.

The information presented in this chapter is detailed in the exhibits in Appendix B to this study. The derivation of the coefficients of the variables in the regression equations and the statistical attributes of those equations are explained in the following paragraphs. With each equation is a summary of the features that the regression equation indicates are present in the data.

When values are substituted for variables in the equations, those values are the mean values for that particular area as shown in tables B21 to B30. The reader should be cautioned to disregard the dollars and cents accuracy of the cost computations presented in this chapter. The purpose of the

cost calculations is to be representative of the expected level of costs. Actual values for the variables computed by the equations will vary randomly around the mean values described by the equations. The actual costs would, therefore, also vary.

A. REGRESSION EQUATIONS.

This section contains regression equations relating ten variables pertinent to analyses of MEP activities. The 24 observations represent three quarters' data for each of eight areas. The three quarters are 4th quarter, 1973, and 1st and 2nd quarters, 1974. The areas, again , are the Coast Guard jurisdictions for the Captain of the Port or Port Safety Offices in Seattle, Portland, Concord, San Francisco, Monterey, Humboldt Bay, Los Angeles/Long Beach, and San Diego.

The ten variables and the numbers by which they are identified here are as follows:

1. Millions of barrels of petroleum transferred.
2. Tank vessel transits.
3. Petroleum handling waterfront facilities.
4. Number of cleanups in which Coast Guard personnel participated.
5. Coast Guard man-hours used in those cleanups.
6. Number of spills reported.
7. Volume of oil spilled.
8. Coast Guard man-hours used in spill investigations.

9. Coast Guard man-hours used in MEP administrative activites.

10. Coast Guard man-hours used in MEP support activities.

Included in the following pages are the specific results of the data analyses - the regression equations and the correlation matrices. Presented with each analysis are the values of the regression coefficients of determination (r^2), the t values and corresponding significance levels for each equation, and an interpretation of the meaning of the regression equation.

The analyses were performed using the SNAP/IEDA statistical computing package. The following explanation of terms accompanies each regression equation in the computer printouts and applies to all of the ensuing equations herein:

> The following is a table of coefficients of each independent variable and related calculation for each step in the regression. Elements in bold face (underlined) are the coefficients of variables in the regression at the end of that step. The other coefficients are those which would have resulted at that step had the corresponding variable entered the regression instead of the variable which in fact entered. M-R2 is the square of the multiple correlation between the dependent variable and those independent variables which were included in the regression at that step. F is the ratio of the variance of the residuals of the dependent variable before the present step & the variance of the residuals of that variable after the present step. SE-DPV is the standard error of the dependent variable after removing the effects of the independent variable in the regression at that step. SE is the standard error of each coefficient in the regression. R2 is the square of the correlation of the independent variable and the dependent variable after removing the effect of the other independent variables in the regression.

1. The following equation is the result of regressing variables X(1), X(2), and X(3) against variable X(6):

STEP		M-R2	F	SE-DPV	CONSTANT	X(1)	X(2)	X(3)
1		9.852	126.4	35.364	16.202	1.493	0.094	2.643
	STD. ERROR						0.008	
	PAR.R2						0.852	
2		0.895	8.5	29.813	7.275	-0.440	0.063	1.093
	STD. ERROR						0.013	0.374
	PAR.R2						0.549	0.289
	t values:						4.84	2.92
Corresponding significance levels							.0005	.005

At step 2, the regression equation, X(7)=7.275+.063 X(2)+ 1.093 X(3), explains 89.5% of the variation in variable (6). 24 observations were included in the analysis. It indicates that the number of spills in an area vary directly with the number of tank vessel transits and the number of petroleum handling waterfront facilities. The strength of association between the variables is demonstrated in the following matrix:

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(6)
X(1)	1.00	0.67	0.25	0.54
X(2)	0.67	1.00	0.82	0.92
X(3)	0.25	0.82	1.00	0.88
X(6)	0.54	0.92	0.88	1.00

2. The following equation is the result of regressing variable X(7) against variable X(5):

STEP		M-R2	F	SE-DPV	CONSTANT	X(7)
1		0.026	0.4	******	152.278	-0.077
	STD.ER					0.118
	PAR.R2					0.026

t value:	.65
Corresponding significance level:	.3

This regression equation shows that there is little statistical relationship between variable (7) and variable (5). Volume of oil spilled does not explain the number of man-hours that Coast Guard personnel expended in cleanups. Thus, it seems that gross spill volume in an area is not an indicator of how many spills are to be cleaned up and what level of effort is necessary. The following matrix shows the lack of strength of association:

CORRELATION MATRIX

	X(7)	X(5)
X(7)	1.00	-0.16
X(5)	-0.16	1.00

3. The following equation resulted from regressing variable X(6) against variable X(8):

STEP	M-R2	F	SE-DPV	CONSTANT	X(6)
1	0.746	47.0	******	6.066	3.437
STD.ER					0.501
PAR.R2					0.746
t value:					6.86
Corresponding significance level:					.0005

This equation results from analysis of 18 observations, excluding data from the Los Angeles/Long Beach and Concord areas. The resultant equation, X(8)=6.066+3.437 X(6), explains 74.6% of the variation in X(8), man-hours of investigation. It indicates that the number of hours of investigation are directly and strongly related to the number of spills in

an area. The following correlation matrix exhibits the strength of association between the two variables:

CORRELATION MATRIX

	X(6)	X(8)
X(6)	1.00	0.86
X(8)	0.86	1.00

4. The following equation results from regressing variables X(4) and X(6) against variable X(9):

STEP	M-R2	F	SE-DPV	CONSTANT	X(4)	X(6)
1	0.534	18.3	******	150.568	87.684	7.137
STD.ER						1.666
PAR.R2						0.534
t value:						4.28
Corresponding significance level:						.0005

This regression was performed using 18 observations, excluding data from Los Angeles/Long Beach and Concord areas. Those units used different criteria in reporting than other units. The resultant equation, X(9)=150.568 + 7.137 X(6), explains 53.4% of the variation in the man-hours spent of MEP administrative activities. Using X(4), number of clean-ups, provided no significant increase in the explanatory power of the regression. The relative stregths of association are exhibited in the follwoing correlation matrix:

CORRELATION MATRIX

	X(4)	X(6)	X(9)
X(4)	1.00	0.51	0.23
X(6)	0.51	1.00	0.73
X(9)	0.23	0.73	1.00

5. The following equation results from regressing variables X(4) and X(6) against variable X(10):

STEP	M-R2	F	SE-DPV	CONSTANT	X(4)	X(6)
1	0.364	9.2	******	120.132	54.153	2.760
STD.ER						0.912
PAR.R2						0.364
t value:						3.02
Corresponding significance level:						.005

This regression was performed with 18 observations, again excluding the Los Angeles/Long Beach and Concord data. The resultant equation, X(10)=120.132 + 2.76 X(6), explains 36.4% of the variation in the number of man-hours of MEP support in an area. The variable X(4) did not provide any significant increase in explanatory power when it was included. The relative strength of association between the variables in exhibited in the following matrix:

CORRELATION MATRIX

	X(4)	X(6)	X(10)
X(4)	1.00	0.51	0.31
X(6)	0.51	1.00	0.60
X(10)	0.31	0.60	1.00

6. The following equation results from regressing variables X(6) X(7), and X(4) against variable X(5):

STEP	M-R2	F	SE-Dpv	CONSTANT	X(6)	X(7)	X(4)
1	0.039	0.6	******	80.565	-0.425	-0.077	21.672
STD.ER							26.941
PAR.R2							0.039
2	0.132	1.4	******	155.147	-0.964	-0.094	40.539
STD.ER					0.805		30.900
PAR.R2					0.087		0.103
3	0.135	0.2	******	167.096	-0.843	-0.056	40.169
STD.ER					0.872	0.127	31.781
PAR.R2					0.063	0.013	0.102
t values:					.966	.44	1.26
Corresponding significance levels:					.25	.4	.15

This regression was performed with all 24 observations. The resultant equation explains little, as indicated by the low r^2, the low t values and high significance level. It, therefore, appears that man-hours spent in cleanup have little relationship to number of spills, volume spilled, and the number of cleanups. Perhaps the size of individual spills would provide greater explanatory power. The relative lack of strength of association is exhibited in the following correlation matrix:

CORRELATION MATRIX

	X(6)	X(7)	X(4)	X(5)
X(6)	1.00	0.35	0.51	-0.15
X(7)	0.35	1.00	0.16	-0.16
X(4)	0.51	0.16	1.00	0.20
X(5)	-0.15	-0.16	1.00	0.20

7. The following equation results from regressing variables X(1), X(2), and X(3) against variable X(4):

STEP	M-R2	F	SE-DPV	CONSTANT	X(1)	X(2)	X(3)
1	0.429	12.0	1.865	-0.064	-0.007	0.002	0.046
STD.ER							0.013
PAR.R2							0.429
2	0.725	16.1	1.296	0.324	-0.098	-0.000	0.075
STD.ER					0.025		0.012
PAR.R2					0.517		0.724
t values:					3.92		6.25
Corresponding significance levels:					.001		.0005

This regression was performed using 18 observations, excluding Los Angeles/Long Beach and Concord area data. The resultant equation, $X(4) = .324 - .098\ X(1) + .075\ X(3)$, explains 72.5% and was judged to be a more appropriate representation of actual relationships. Los Angeles/Long Beach and Concord sometimes used different criteria in their reports. Petroleum transferred and number of petroleum handling facilities in an area appear to provide a good prediction of the number of cleanups in which Coast Guard personnel participate. The strength of associations is exhibited in the following matrix showing the inverse relationship of X(1) to X(4):

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(4)
X(1)	1.00	0.70	0.60	-0.04
X(2)	0.70	1.00	0.93	0.59
X(3)	0.60	0.93	1.00	0.66
X(4)	-0.04	0.59	0.66	1.00

8. The following equation results from regressing variables X(1), X(2), and X(3) against variable X(7):

STEP	M-R2	F	SE-DPV	CONSTANT	X(1)	X(2)	X(3)
1	0.183	3.6	******	177.174	8.177	0.191	6.911
STD.ER							3.652
PAR.R2							0.183
2	0.258	1.5	******	183.496	-0.501	-0.487	18.574
STD.ER					0.395		10.104
PAR.R2					0.092		0.184
3	0.278	0.4	******	158.930	6.697	-0.628	19.994
STD,ER					10.816	0.462	10.570
PAR.R2					0.027	0.116	0.204
t values:					.619	1.35	1.89
Corresponding significance levels:					.30	.10	.05

This regression was performed with all 24 observations. The resultant equation at step (1), X(7)= 177.174 + 6.911 X(3), appears most reasonable even though it only explains 18.3% of the variation. It shows the direct relationship between petroleum handling facilities and volume spilled at a .05 significant level. The small F values indicate the lack of strength in this relationship. Other factors not analyzed may provide better predictors, or the data may provide better prediction with a curvilinear fit. The correlation matrix is as follows:

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(7)
X(1)	1.00	0.70	0.60	0.25
X(2)	0.70	1.00	0.93	0.30
X(3)	0.60	0.93	1.00	0.43
X(7)	0.25	0.30	0.43	1.00

9. The following equation results from regressing variables X(1), X(2), and X(3) against variable X(6):

STEP	M-R2	F	SE-DPV	CONSTANT	X(1)	X(2)	X(3)
1	0.897	140.0	30.363	11.959	3.543	0.097	2.564
STD.ER							0.217
PAR.R2							0.897
t value:							11.81
Corresponding significance level:							.0005

This regression was performed using 18 observations, excluding data from Los Angeles/Long Beach and Concord areas. The resultant equation, X(6)= 11.959 + 2.564 X(3), may well be the most important of all the analyses. It shows that for 6 areas, the number of petroleum handling facilities is an excellent predictor of the number of spills in an area. The strength of association between the variables is exhibited in the following correlation matrix:

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(6)
X(1)	1.00	0.70	0.60	0.63
X(2)	0.70	1.00	0.93	0.92
X(3)	0.60	0.93	1.00	0.95
X(6)	0.63	0.92	0.95	1.00

10. The following correlation matrix exhibits the relative strengths of associations between all 10 of the variables considered in the above analyses:

CORRELATION MATRIX

	X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)	X(9)	X(10)
)	1.00	0.70	0.60	-0.04	-0.09	0.63	0.25	0.63	0.79	0.63
)	0.70	1.00	0.93	0.50	-0.09	0.92	0.30	0.83	0.73	0.76
)	0.60	0.93	1.00	0.66	-0.05	0.95	0.43	0.81	0.74	0.53
)	-0.04	0.59	0.66	1.00	0.20	0.51	0.16	0.42	0.23	0.31
)	-0.09	-0.09	-0.05	0.20	1.00	-0.15	-0.16	-0.16	-0.19	-0.20
)	0.63	0.92	0.95	0.51	-0.15	1.00	0.35	0.86	0.73	0.60
)	0.25	0.30	0.43	0.16	-0.16	0.35	1.00	0.28	0.29	-0.03
)	0.63	0.83	0.81	0.42	-0.16	0.86	0.28	1.00	0.76	0.65
)	0.69	0.73	0.64	0.23	-0.19	0.63	0.20	0176	1.00	0.62
))	0.63	0.76	0.53	0.31	-0.20	-.60	-0.03	0.65	0.62	1.00

B. INVESTIGATION COSTS

First, the cost of investigation will be estimated. The factors discussed below contribute to that total cost. The equations and coefficients used to estimate costs are those derived from the regression analysis described in the preceding section.

1. The number of spills in each area to which investigators must respond will be determined from the following regression equation:

$$X(6) = 7.275 + .063X(2) + 1.093X(3)$$

where $X(6)$ = Number of spills per quarter,

$X(2)$ = Tank vessel transits, and

$X(3)$ = Petroleum handling facilities.

2. The number of man-hours spent in investigation and the number of man-hours of standby time will be determined from the following equation:

$$.15X(8) = 6.066 = 3.437X(6)$$

where $X(8)$ = Man-hours related to investigation,

$.15X(8)$ = man-hours spent on investigations,

$.85X(8)$ = man-hours spent in standby for investigation, and

$X(6)$ = Number of spills per quarter.

3. The average vehicle use hours (2.26) and average boat use hours (.18) per investigation will be used to relate the use of this equipment to the number of spills in an area.

4. The cost of facilities necessary to provide office space, garage space, dock space and storage space for personnel, vehicles and boats will be estimated from standard costs and commercial firms, price lists.

5. The cost of personnel transfers, procurement and training will be estimated from standard Coast Guard costs.

The equations and values for the first three of the five factors listed above for each area follow directly from the results of the data analysis outlined in the preceding chapter. Costs for those factors will be determined using standard rates. Personnel costs used are those used in the development of estimates as given in Coast Guard Commandant Notice 7100. [ref.57] These costs include pay and related expenses, transfer expenses, accommodations expenses, and personnel training and procurement expenses based on existing pay levels as of 1 January 1974. The assumed pay will be that of a Petty Officer First Class (E-6) to represent the average pay level for personnel involved in Coast Guard investigative activities.

The choice of pay level followed from interviews with local Coast Guard unit personnel. Other costs were assigned on a percentage basis as indicated by the personnel assigned to MEP billets on the West Coast, as shown in Table B17. Excluding District Office personnel, 77% of the people assigned are enlisted. Thus, the personnel costs are $6.052 per man-hour, based on a 2,080-hour work year.

The personnel costs for the areas considered herein were calculated as follows from Coast Guard Commandant Notice 7100:

1. Annual pay and related expenses for Coast Guard unit level personnel (average grade E-6, 23% officer, 77% enlisted) are as follows:

   a. Average pay - $10,600.

   b. Transfer costs = $1,014.70

   c. Unit operating and maintenance costs - $390.

   d. Training and procurement costs - $583.60.

   e. Total (12588.30)/2080 = $6.052 per hour.

2. Annual pay and related expenses for Coast Guard personnel at the district office level (75% officer, 25% enlisted grade E-5 as shown in exhibit B17).

   a. Average officer pay - $18,200.

   b. Transfer costs - $1,700.

   c. District operating and maintenance costs - $2,850.

   d. Training and Procurement costs - $1138.

   e. Total officer-related = $23888(.75) = $17,916.

f. Average enlisted pay - \$8,600.

g. Transfer costs - \$810.

h. District operating and maintenance costs - \$1,650.

i. Training and procurement costs - \$418.

j. Total enlisted-related - \$11,478(.25 = \$2,869.50.

k. Total average district personnel costs per year equals \$20,785.50.

Boat cost will be calculated at a rate of \$25 per hour of use. This cost represents an average of prices cited in the commercial firms' price lists for boats in the 30 - 40 foot length range. It also approximates the prices for boat use presented in the Batelle-Northwest study [ref.20] , as shown in Table B19. This price does not include crew costs, but the cost can be expected to include depreciation allowances, for docking, storage, operation and maintenance.

Vehicle charges will be calculated at a rate of \$5 per hour of use. This charge was calculated in a manner similar to the boat use charge. It represents prices for a vehicle in the sedan, van or pickup category. This price can be expected to include depreciation and allowances for garaging, operation and maintenance.

Thus, calculation of the costs based on the above rates and the results of the data analysis will produce an approximation of the cost of investigation for each area for each

quarter. The cost of administration and support of investigation activities will be treated separately, since those costs also are incurred for cleanup activities. The data available did not allow specific identification of administrative and support costs with either investigation or cleanup.

The costs of investigation activities in each area per quarter are presented in the following paragraphs.

The cost of investigation in the Seattle area is calculated as follows:

1. X(6) = 7.275 + .063(2098) + 1.093(98)

   = 247 spills per quarter.

2. .15X(8) = 6.066 + 3.437(247)

   = 855 man-hours per quarter.

   X(8) = 5,700 total investigation man-hours.

3. Vehicle hours = 2.26(247) = 558.22 per quarter.

4. Boat hours = .18(247) = 44.46 per quarter.

5. Total cost = $6.052(5700) + $5(558.22)

   + $25(44.46) = $38,399 per quarter.

The cost of investigation in the Portland area is calculated as follows:

1. X(6) = 7.275 + .063(1771) + 1.093(68)

   = 193 spills per quarter.

2. .15X(8) = 6.066 + 3.437(193)

   = 669.4 man-hours per quarter

   x(8) = 4462.7 total investigation man-hours

3. Vehicle hours = 2.26(193) = 436.18 per quarter.

4. Boat hours = .18(193) = 34.74 per quarter.

5. Total cost = \$6.052(4462.7) + \$5(436.18)

   + \$25(34.74) = \$30,058 per quarter.

The cost of investigation in the Concord area is calculated as follows:

1. X(6) = 7.275 + .063(546) + 1.093(26)

   = 70 spills per quarter.

2. .15X(8) = 6.066 + 3.437(70)

   = 246.66 man-hours per quarter.

   X(8) = 1644.4 total investigation man-hours.

3. Vehicle hours = 2.26(70) = 158.2 per quarter.

4. Boat hours = .18(70) = 12.6 per quarter.

5. Total cost = \$6.052(1644.4) + \$5(158.2)

   = \$25(12.6) = \$11,064 per quarter.

The cost of investigation in the San Francisco area is calculated as follows:

1. X(6) = 7.275 + .063(1511) + 1.093(37)

   = 143 spills per quarter.

2. .15X(8) = 6.066 + 2.437(143)

   = 497.56 man-hours per quarter.

   X(8) = 3317.05 total investigation man-hours.

3. Vehicle hours = 2.26(143) = 323.18 per quarter.

4. Boat hours = .18(143) = 25.74 per quarter.

5. Total cost = \$6.952(3317.05) + \$5(323.18)

   + \$25(25.74) = \$22,335 per quarter.

The cost of investigation in the Monterey area is calculated as follows:

1. X(6) = 7.275 + .063(112) + 1.093(8)

= 23 spills per quarter.

2. .15X(8) = 6.066 + 3.437(23)

= 85.12 man-hours per quarter.

X(8) = 467.45 total investigation man-hours,

3. Vehicle hours = 2.26(23) = 51.98 per quarter.

4. Boat hours = .18(23) = 4.14 per quarter.

5. Total cost = $6.052(567.45) + $5(51.98)

= $25(4.14) = $3,798 per quarter.

The cost of investigation in the Humboldt Bay area is calculated as follows:

1. X(6) = 7.275 + .063(89) + 1.093(6)

= 19 spills per quarter.

2. .15X(8) = 6.066 + 3.437(19)

= 71.37 man-hours per quarter.

X(8) = 475.79 total investigation man-hours.

3. Vehicle hours = 2.26(19) = 42.94 per quarter.

4. Boat hours = .18(19) = 3.42 per quarter.

5. Total cost = $6.052(475.79) + $5(42.94)

+ $25(3.42) = $3,180 per quarter.

The cost of investigation in the Los Angeles/Long Beach calculated as follows:

1. X(6) = 7.275 + .063(2233) + 1.093(39)

= 191 spills per quarter.

2. .15X(8) = 6.066 + 3.437(191)

= 662.53 man-hours per quarter.

X(8) = 4416.89 total investigation man-hours.

3. Vehicle hours = 2.26(191) = 431.66 per quarter.

4. Boat hours = .18(191) = 34.38 per quarter.

5. Total cost = $6.052(4416.89) + $5(431.66)

+ $25(34.38) = $29,749 per quarter.

The cost of investigation in the San Diego are is calculated as follows:

1. X(6) = 7.275 + .063(50) + 1.093(15)

= 27 spills per quarter.

2. .15X(8) = 6.066 + 3.437(27)

= 98.87 man-hours per quarter.

3. Vehicle hours = 2.26(27) = 61.02 per quarter.

4. Boat hours = .18(27) = 4.86 per quarter.

5. Total cost = $6.052(659.1) + $5(61.02)

+ $25(4.86) = $4,415 per quarter.

Summarizing the costs of investigation for each of the areas listed above produces a total of $142,997. This represents the total cost of investigation activities in the 11th, 12th and 13th Coast Guard Districts, as defined by those investigation cost factors previously delineated.

C. CLEANUP COSTS

The costs of cleanup activities will now be estimated by the same basic procedures as used for investigation. The following factors contribute to that total cost:

1. The number of spills in each area in which Coast Guard personnel participate in cleanup activities will be determined from the following regression equation:

$$X(4) = .324 - .098X(1) + .975X(3)$$

where $X(4)$ = Cleanups with Coast Guard participation.

$X(1)$ = Petroleum transferred in the area, and

$X(3)$ = Petroleum handling facilities.

2. The number of man-hours that Coast Guard personnel spent in cleanup activities is calculated from the average of 66.36 hours per cleanup.

3. Coast Guard vehicle and boat use will be calculated from their averages per cleanup (17.6 hours and .29 hours, respectively).

4. Cleanups occurred that were funded under Coast Guard contract but were not participated in directly by Coast Guard personnel. Federally funded cleanups average 5% of all spills in the 11th, 12th and 13th Coast Guard Districts in 1973. That figure will be used to estimate the cost of commercial responses to pollution incidents. The commercial figures will, naturally, include allowances for labor expenses, equipment rentals, and such overhead items as office space, maintenance, insurance, and similar costs. These figures also include a normal 10% profit margin, as shown in the commercial price lists. This margin will be deducted from the commercial averages to provide an indication of the cost if the cleanup had been performed by federal or state agencies.

5. Coast Guard personnel and equipment costs will include allowances for accommodations, storage, transfers, procurement and training, as in the calculation of investigation costs.

6. No data were available concerning standby hours of

Coast Guard personnel for cleanup response. The standby time factor applied for investigation means that personnel would also be available for cleanup. The same personnel are available for both tasks.

7. Commercial charges would naturally include allowances for standby hours reasonably attributable to pollution incident response.

Coast Guard cost rates used for cleanup operation will be the same as those applied to the calculation of investigation cost. The personnel, vehicles and boats involved would be the same as for the investigation activities.

Commercial charges will be included as a gross average, less a 10% profit margin. The averages will be different in each of the 11th, 12th and 13th Coast Guard Districts, since there is a substantial difference in the average costs, as the following comparison shows:

11th District: $2,443,50 per cleanup

12th District: $3,033.00 per cleanup

13th District: $1,236,60 per cleanup

The differences in average cleanup costs can be attributed to such factors as public concern, relative costs of living, geographical differences, and environmental differences, among others.

The costs of cleanup activities in each area, per quarter, are presented in the following paragraphs.

The cost of cleanup in the Seattle area is calculated as follows:

1. Spills per quarter = 247 (previously determined).

2. X(4) = .324 - .098(35.667) + .075(98)

= 4.2 cleanups with Coast Guard participation.

3. Commercial cleanups under Federal contract: .05(247) = 12.35 per quarter.

4. Coast Guard man-hours: 66.36(4.2) = 278 man-hours per quarter.

5. Coast Guard vehicle hours: 17.6(4.2) = 73.92 per quarter.

6. Coast Guard boat hours: .29(4.2) = 1.22 per quarter.

7. Commercial cleanup costs: $1,236.60(12.35) = $15,272 per quarter.

8. Total cost: $6.052(278.7) + $5(73.92) + $25(1.22) + $15,272 = $17,359.

The cost of cleanup in the Portland area is calculated as follows:

1. Spills per quarter: 193.

2. X(4) = .324 - .098(9.367) + .075(68)

= 4.5 cleanups with Coast Guard participation.

3. Commercial cleanups under Federal contract: .05(193) = 9.65 per quarter.

4. Coast Guard man-hours: 66.36(4.5) = 298.62

man-hours per quarter.

5. Coast Guard vehicle hours: 17.6(4.5) = 79.2 per quarter.

6. Coast Guard boat hours: .29(4.5) = 1.3 per quarter.

7. Commercial cleanup costs: $1236.60(9.65) = $11,933 per quarter.

8. Total cost: $6.052(298.62) + $5(79.2) + $11,933 = $14,169.

The cost of cleanup in the Concord area is calculated as follows:

1. Spills per quarter = 70.

2. X(4) = .324 - .098(34.867) + .075(26) = 0 cleanups with Coast Guard participation.

3. Commercial cleanups under federal contract = .05(70) = 3.5 per quarter.

4. Commercial cleanup costs = $3033(3.5) = $10,615.50 per quarter.

5. Total cost = $10,615.50 per quarter.

The cost of cleanup in the San Francisco area is calculated as follows:

1. Spills per quarter = 143.

2. X(4) = .324 - .098(35) + .075(37) = 0 per quarter.

3. Commercial cleanups under federal contract = .05(143) = 7.15 per quarter.

4. Commercial cleanup costs = \$3033(7.15) = \$21,685.95 per quarter.

5. Total costs = \$21,685.95 per quarter.

The cost of cleanup in the Monterey area is calculated as follows:

1. Spills per quarter = 23.

2. $X(4) = .324 - .098(8.8) + .075(8) = .06$ per quarter.

3. Commercial cleanups under federal contract = .05(23) = 1.15 per quarter.

4. Coast Guard manhours = 66.36(.06) = 3.98 per quarter.

5. Coast Guard vehicle hours = 17.6(.06) = 1.06 per quarter.

6. Coast Guard boat hours = .29(.06) = .02 per quarter.

7. Commercial cleanup costs = \$3033(1.15) = \$3487.95 per quarter.

8. Total cost = \$6.052(3.98) + \$5(1.06) + \$25(.02) + \$3487.95 = \$3517.84 per quarter.

The cost of cleanup in the Humboldt Bay area is calculated as follows:

1. Spills per quarter = 19.

2. $X(4) = .324 - .098(.633) + .075(6) = .71$ per quarter.

3. Commercial cleanups under federal contract = .05(19) = .95 per quarter.

4. Coast Guard man-hours = 66.36(.71) = 47.12 per quarter.

5. Coast Guard vehicle hours = 17.6(.71) = 12.5 per quarter.

6. Coast Guard boat hours = .29(.71) = .21 per quarter.

7. Commercial cleanup costs = $3033(.95) = $2881,35 per quarter.

8. Total cost = $6.052(47.12) + $5(12.5) + $25(.21) + $2881,35 = $3234.27 per quarter.

The cost of cleanup in the Los Angeles/Long Beach area is calculated as follows:

1. Spills per quarter = 191.

2. X(4) = .324 - .098(103.067) + .075(39) = 0.

3. Commercial cleanups under federal contract = .05(191) = 9.55 per quarter.

4. Commercial cleanup costs = $2443.50(9.55) = $23,335.42 per quarter.

5. Total cost = $23,335.42 per quarter.

The cost of cleanup in the San Diego area is calculated as follows:

1. Spills per quarter = 27.

2. X(4) = .324 - .098(1.3) + .075(15) = 1.32 cleanups with Coast Guard participation.

3. Commercial cleanups under federal contract = .05(27) = 1.35 per quarter.

4. Coast Guard man-hours = 66.36(1.32) = 87.6 per quarter.

5. Coast Guard vehicle hours = 17.6(1.32) = 23.23 per quarter.

6. Coast Guard boat hours = .29(1.32) = .38 per quarter.

7. Commercial cleanup costs = $2443.50(1.35) = $3298.72 per quarter.

8. Total cost = $6.052(87.6) + $5(23.23) + $25(.38) + $3298.72 = $3954.53 per quarter.

Totalling the costs of cleanup for all of the areas listed above produces the figure of $97,871,25. This represents the total cost of cleanup in the 11th, 12th, and 13th Coast Guard Districts, as defined by the cleanup cost factors previously delineated.

D. ADMINISTRATION, SUPPORT, AND OVERHEAD COSTS

These costs are the Coast Guard costs that can be identified with general support of investigation and/or cleanup activities. The following cost factors contribute to the total:

1. Administrative hours at the Coast Guard unit levels will be estimated by using the regression equation $X(9) = 150.568 + 7.137X(6)$, where $X(9)$ is administrative man-hours and $X(6)$ is number of spills in that area quarterly.

2. Support hours at the Coast Guard unit levels will be estimated by using the regression equation

X(10) = 120.132 + 2.76X(6), where X(10) is support man-hours and X(6) is number of spills, as before.

3. The administrative costs at the Coast Guard District Office level will be estimated grossly. Interviews with district personnel indicate that roughly one-half of their working time can be directly related to investigation and cleanup activities. The rest of their time, while still expended on MEP tasks, is better allocated directly to other MEP activities.

4. Personnel costs will be determined in the same manner as for investigation and cleanup at the unit level. A more appropriate cost rate for district personnel shall be determined to indicate the higher percentage of officers at that level. 75% of those assigned to MEP billets at the district level are officers with an average rank of lieutenant (0-3). Thus, the district charge for personnel will be the full charge of $20.785.50, which represents total personnel cost for the average district MEP administrator, reduced by 50% to $10,392.75 to reflect time spent on investigation and cleanup. There is a total of twelve men assigned at the district level in the 11th, 12th, and 13th districts, so the total administrative expense for the three districts equals $124,713 per year or $31,178.25 per quarter.

4. Finally, an overhead charge of 25% of the total for all investigation and cleanup-related activities will be included. This 25% rate was chosen from an average of overhead charges in the commercial price lists and substantiated as a reasonable estimate of overhead expense by Coast Guard

district and local unit personnel. Claims for reimbursement of local unit expense under the Revolving Fund often included a 25% charge for overhead.

The administrative and support costs for each area are presented in the following paragraphs.

Those costs for the Seattle area are calculated as follows:

1. Spills per quarter = 247 as previously calculated.

2. X(9) = 150.568 + 7.137(247) = 1913.41 man-hours per quarter.

3. X(10) = 120.132 + 2.76(247) = 801.85 man-hours per quarter.

4. Total cost = $6.052(1913.41 + 801.85) = $16.432.76 per quarter.

Those costs for the Portland area are calculated as follows:

1. Spills per quarter = 193.

2. X(9) = 150.568 + 7.137(193) = 1528.01 man-hours per quarter.

3. X(10) = 120.132 + 2.76(193) = 652.81 man-hours per quarter.

4. Total cost = $6.052(1528.01 + 652.81) = $13,198.32 per quarter.

Those costs for the Concord area are calculated as follows:

1. Spills per quarter = 70.

2. X(9) = 150.568 + 7.137(70) = 650.16 man-hours per quarter.

3. X(10) = 120.132 + 2.76(70) = 313.33 man-hours per quarter.

4. Total costs = \$6.052(650.16 + 313.33) = \$5831.04 per quarter.

Those costs for the San Francisco area are calculated as follows:

1. Spills per quarter = 143.

2. X(9) = 150.568 + 7.137(143) = 1171.16 man-hours per quarter.

3. X(10) = 120.132 + 2.76(143) = 514.81 = man-hours per quarter.

4. Total cost = \$6.052(1171.16 + 514.81) = \$10,203.50 per quarter.

Those costs for the Monterey area are calculated as follows:

1. Spills per quarter = 23.

2. X(9) = 150.568 + 7.137(23) = 314.72 man-hours per quarter.

3. X(10) = 120.132 + 2.76(23) = 183.61 man-hours per quarter.

4. Total cost = \$6.052(314.72 + 183.61) = \$3015.91 per quarter.

Those costs for the Humboldt Bay area are calculated as follows:

1. Spills per quarter = 19.

2. X(9) = 150.568 + 7.137(19) = 286.17 man-hours per quarter.

3. X(10) = 120.132 + 2.76(19) = 172.57 man-hours per quarter.

4. Total cost = $6.052(286.17 + 172.57) = $2776.31 per quarter.

Those costs for the Los Angeles/Long Beach area are calculated as follows:

1. Spills per quarter = 191.

2. X(9) = 150.568 + 7.137(191) = 1513.74 man-hours per quarter.

3. X(10) = 120.132 + 2.76(191) = 647.29 man-hours per quarter.

4. Total cost = $6.052(1513.74 + 647.29) = $13,078.56 per quarter.

Those costs for the San Diego area are calculated as follows:

1. Spills per quarter = 27.

2. X(9) = 150.568 + 7.137(27) = 343.27 man-hours per quarter.

3. X(10) = 120.132 + 2.76(27) = 194.65 man-hours per quarter.

4. Total cost = $6.052(343.27 + 194.65) = $3255.50 per quarter.

The overall total of the above administrative and support costs at unit levels is $67,791.90 per quarter. The total with the district charge of $31,178.25 is $98.970.15 per quarter.

The total for all three districts are as follows: (1) investigation: $142,996.92, (2) cleanup: $97,871.25, and (3) administrative and support: $98,970.15. These sum to $339,838.32 per quarter. The 25% charge for overhead makes the grand total $424,797.90 per quarter or $1,699,191.60 per year.

The results of these calculations are summarized in Table 1. The total cost of investigation, cleanup, administration and support has now been estimated for the 11th, 12th , and 13th Coast Guard Districts. The cost for any area can be calculated using the formula shown in exhibit 2.

EXHIBIT 1

SUMMARY OF QUARTERLY MEP COST ESTIMATES

AREA	INVEST	CLEANUP	ADMIN/ SUPPORT	TOTAL
Seattle	$38399.00	$17358.89	$16432.76	$72190.56
Portland	30057.66	14168.94	13198.32	57424.92
Concord	11064.49	10615.50	5831.04	27511.03
San Francisco	22334.19	21685.95	10203.50	54223.64
Monterey	3797.61	3517.84	3015.91	10331.36
Humboldt Bay	3179.68	3234.27	2776.31	0190.26
Los Angeles/ Long Beach	29748.82	23335.42	13078.56	66162.80
San Diego	4415.47	3954.63	3255.50	11625.60
District Offices	-	-	31178.25	31178.25
Subtotals	$142996.92	97871.25	98970.15	$339838.32
Overhead				84959.58
Total				424,797.90

$$\left.\begin{aligned}\text{Total cost} = {} & (\$5.052/.15)\ 6.066 + 3.437\ 7.275 + .063X(2) + 1.093X(3) \\ & + \$5\ 2.26\ 7.275 + .063X(2) + 1.093X(3) \\ & + \$25\ .18\ 7.275 + 0.63X(2) + 1.093X(3)\end{aligned}\right\}\ \text{Investigation costs}$$

$$\left.\begin{aligned} & + \$6.052\ 66.36\ .324 - .098X(1) + .075X(3) \\ & + \$5\ 17.6\ .324 - .098X(1) + .075X(3) \\ & + \$25\ .29\ .324 - .09x(1) + .075X(3) \\ & + C\ .05\ 7.275 + 063X(2) + 1.093X(3)\end{aligned}\right\}\ \text{Cleanup costs}$$

$$\left.\begin{aligned} & + \$6.052\ 150.568 = 7.137\ 7.275 + .063X(2) + 1.093X(3) \\ & + \$6.052\ 120.132 + 2.76\ 7.275 + .063X(2) + 1.093X(3)\end{aligned}\right\}\ \text{Local administrative and support costs}$$

$$\left. + \$31{,}178.25/8\ \ 1.25 \right\}\ \text{District and Overhead costs}$$

Note: C is the average cost of commercial cleanups less profit in the area. It is assumed that district cost is allocated equally to each area.

V. CONSIDERATIONS IN THE STATES ASSUMING CERTAIN MEP FUNCTIONS

Establishing the costs of investigation and cleanup activities as performed by or for the U.S. Coast Guard is the first step in predicting the costs to the states of assuming those MEP functions. Differences in organization, levels of activity, political influences, and other factors have to be considered in predicting costs to the states. Assumptions will have to be made to delimit the considerations.

The objectives or purposes of the states' performance of MEP functions are, again,

1. Equipment stockpiling, maintenance and use in pollution incident response and

2. Investigation of the causes of pollution incidents and forwarding reports to the Coast Guard for appropriate legal action.

To accomplish those broad objectives, the following program elements appear to be necessary and sufficient:

1. Investigative activity.
2. Cleanup activity.
3. Training activity.
4. Administrative and support activity.[4]

The costs of each of these activities to the Coast Guard

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[4]The last two activities are, of course, interrelated to each of the other activities.

were addressed in the previous chapter. Those costs may differ when one considers a state organization.

One must realize that the level of response, type of response, and the types of programs in general are subjective in nature. The initial congressional determination that there should be any response at all was the result of political and public influences and subjectively decided.

Assumptions are, therefore, necessary to delineate standards for performance, the geographical extent of the state activity, interagency influences and other influences pertinent to the performance of MEP functions. These assumptions should define a relationship between costs to the states and the costs to the Coast Guard previously determined.

First, standards of performance for a state MEP organization are assumed to be those Marine Environmental Protection program standards promulgated for Coast Guard units by the Commandant of the Coast Guard in Commandant Instruction 3120.11 dated 8 January 1973. [ref.58] This instruction sets the minimum Marine Environmental Protection performance standards for the Coast Guard.

Although cleanup policy and standards are provided in Commandant Instruction 3120.11, additional "policy guidance for the removal of oil and hazardous substance discharges into the U.S. navigable waters" has been issued to the Coast Guard and is pertinent to activities of a state MEP organization. This policy guidance is contained in Commandant

Instruction 5922.16 dated 7 December 1973. [ref.60]

> It is Coast Guard policy to ensure that timely and effective action is taken to control and remove all discharges of oil and hazardous substances into or upon U.S. waters, adjoining shorelines, or into or upon the waters of the contiguous zone (normally ocean waters to 12 miles offshore).

Cleanup action may be taken by the spiller. If he does not take appropriate action or he is not identified, action by the state organization would be necessary to remove or arrange for removal of the discharge, unless greater environmental damage would result.

> The magnitude of the task of removing discharged oil and hazardous substances from the marine environment is determined by the combination of circumstances surrounding the discharge:
>
> 1. The source of a discharge may be a vessel as a result of collision, grounding, fire, personnel or equipment failure, or willfullness. Discharges may also occur at transfer facilities, along pipelines, or as a result of offshore drilling operations.
>
> 2. The type of material discharged varies greatly. Oils range from heavy crudes and residuals to light fractions such as gasoline. Hazardous substances (to be designated by the Environmental Protection Agency) may produce a violent reaction with water or other substances, or may produce dangerous fumes or vapors.
>
> 3. The weather conditions during and following the discharge together with the degree of exposure may range from the high seas to a protected area.
>
> 4. The physical character of the affected areas may also vary. The discharges may occur in open water affecting only the water column, or it may wash up on recreational beaches or into marinas. It may reach ecologically sensitive areas such as marshes, marine sanctuaries or breeding grounds, or it may be confined to the vicinity of commercial piers and docks. [ref.60]

The above excerpt from Commandant Instruction 5922.16 was included because it is a clear, concise statement of when cleanup action should be taken and what factors affect that action. Planning for pollution incident response must address those factors and the complications they may create.

A second assumption is necessary to set the criteria for the geographic extent of the activity of a state MEP organization. In making this assumption the following questions and conditions warranted consideration:

1. How should the resources of the Coast Guard and the state organization interface? Initial Coast Guard studies on this subject hypothesized that state response would essentially be limited to those areas in which Coast Guard resources are inadequate. [70,p.12]

2. The Environmental Protection Agency (EPA) has inland federal pollution response responsibility. It presently contracts with state agencies to perform certain response functions because the resources of the EPA are also limited.

3. A state agency has a political responsibility to the state government. Its concern for the ecology of the waters of the state is not easily limited by an arbitrary division of federal agencies' jurisdictions.

4. Efficient use of government funds and the objectives earlier listed for the policy of new Federalism require that suplication of effort by governmental units at all levels be minimized.

In the light of the above considerations, the most appropriate assumption for this study is that state organizations would assume full responsiblility for all investigation and cleanup activities in state waters. A specific identification of the Coast Guard-state geographic interface was beyond the scope of this study.

For the states considered in this study, the costs of state response in areas for which the Environmental Protection Agency has responsibility would not be significant in relation to total costs for those states. This is due simply to the fact that the preponderance of reported spills occur in the coastal waters in these states. Coast Guard reports show that local Coast Guard units are now meeting 100% of the mission performance standards in these states.

It is assumed that the Coast Guard and other federal agencies will maintain their present levels of activity in all MEP functions not assumed by the states. The Coast Guard would continue to perform surveillance, receive reports of spills, and perform all their other MEP functions.

It is assumed that state response methods would be substantially those methods presently employed by Coast Guard personnel in investigation and cleanup. This assumption is reasonable due to the previous assumption on standards of performance and the general nature of investigative procedures.

It is assumed that state cleanup systems will be similar to those utilized by commercial cleanup firms. The selection

of an appropriate inventory of pollution response systems requires a consideration of the physical features of the area, economic factors, environmental protection goals, and legal requirements.

The intent of the Federal Water Pollution Control Act seems to be that oil spills should be removed physically from the water. State laws and federal regulations reinforce that method as the only acceptable one. The National Contingency Plan [ref.67] severely restricts the use of certain response methods. The Coast Guard policy has been mentioned earlier as requiring physical removal of the oil in most circumstances. The commercial cleanup firms have recognized these factors. Their equipment lists are generally limited to that which is used to contain, physically remove, transport, and dispose of spilled oil.

The system chose should be compatible with the sizes of the expected spills. Approximately 87% of all spills are less than 1000 gallons in size. That is one reason why 75% of all expenditures for cleanup under the federal Revolving Fund have been less than $5000. [54,p.2-5]

It is, therefore, appropriate for a state organization to maintain an inventory of equipment designed to contain, physically remove, and dispose of spilled oil. That equipment should be quickly deployable. Table (c4) in appendix C is a hypothetical list of cleanup equipment that would meet the above objectives. This list of cleanup equipment represents

a synthesis of the equipment inventories of Coast Guard units and commercial cleanup firms.

It is assumed that a state organization to perform the MEP functions considered herein would be a separate and distinct organization. The MEP functions would not just become additional collateral duties of an existing state agency. This assumption is reasonable because none of the four states considered in this study now performs cleanups with its own personnel and equipment.

In Washington,

> State personnel do not actively engage in removing spilled oil from the environment. The state does, however, supervise removal projects being conducted by those who discharge oil unlawfully. State personnel also contract with private entities for cleanup of unkown source spills. ...The Department's (Department of Ecology for Washington) oil pollution control programs for 1971, 1972, and 1973 cost approximately $118,500, $135,000, and $75,000 respectively. Man-years for the same periods ran about 3.5, 4.0, and 5.3. [ref.44]

In Oregon,

> The main office program staff of the Department of Environmental Quality consists of two people working 10% of their time in the area of oil spill programming and response. The time spent on oil spill response in the three regions covering the western portion of the state could be estimated at less than 10% of the total work load. Oil spills in Central and Eastern Oregon are infrequent and field response can be estimated at less than 5% of the total work load. [ref.42]

In California and Nevada, any spill response is now a collateral duty of the local representative of the Departments of Fish and Game. Expenditure in California for pollution enforcement activity for 1973 was $296,000 compared to a total

Department budget of $29,200,267. [ref. 40] Nevada does not bother to document pollution abatement expenditures in their budgetary publications. None of the present state agencies have the manpower and equipment to assume full responsibility for pollution investigation and cleanup.

An active role in Marine Environmental Protection would be a new role for state agencies. Assumption of the two MEP functions would necessitate a quantum increase in state MEP activity in all four states. Thus, the assumption of a separate and distinct state MEP organization reflects the reality of the limited amount of present state activity.

A state MEP organization as contemplated herein would then engender adminstrative and organizational relationships previously nonexistent. New interagency relationships would also be generated. The state MEP organization would be expected to be generally self-sufficient. Certainly, they would be able to call on other state agencies (e.g., State Police, Engineering Departments, and the National Guard) for assistance. Existing state resources could also provide benefits such as the following:

1. Time sharing of state computers.
2. Use of state payroll systems
3. Use of state buildings, offices, and storage space.
4. Use of the state communications network.

It is also assumed that a state MEP organization would have personnel training standards similar to those recommended

to the Coast Guard in a study "to evaluate needs and recommend training in Marine Environmental Protection" being performed by Sam Harris Associates, Ltd. [ref.39]

The Coast Guard has operated its Marine Environmental training school for only about one year. Results cannot be fully evaluated now. The present program would allow the training of about 40% of the personnel assigned to MEP operational billets at its maturity.

A state organization would have an advantage. Personnel would be oriented to a single mission. There would be less personnel turnover that at Coast Guard units. More experienced personnel could be employed from the outset. Proposed levels of training might prove even more effective in a state organization. The initial training level would have to be high but could be gradually reduced.

A. RELATIONSHIP OF THE COSTS OF A STATE MEP ORGANIZATION TO THE COSTS PREVIOUSLY CALCULATED

The assumptions listed above provide the groundwork for a consideration of how and why state MEP costs may differ from those previously calculated. First, it is apparent that the cost calculations would be a reasonable estimate of the cost of a state MEP organization if the state organization was similar, in size, missions, administrations, and resources to the U.S. Coast Guard.

State organizations would be expected to meet Coast Guard performance standards. They would have inventories of equipment similar to those of commercial cleanup firms. They would have jurisdiction over an area that is approximately the same as the area over which the Coast Guard has jurisdiction (at least with respect to the probabilities of spill occurrence).

State organizations would also have training requirements similar to those of the Coast Guard. Thus, state MEP organizations could be expected to provide benefits or services at levels similar to those the Coast Guard now provides on the West Coast. The previously calculated costs are, therefore, reasonable estimates of what these functions should cost within the parameters of the data analysis and assumptions made herein. Those calculations should provide the basis for fund allocation, then, and they may be used as criteria for evaluating costs of state operations.

The similarities established mean that any differences between the present costs and state costs must be a function of inherent organizational and procedural differences. The U.S. Coast Guard is a multi-mission federal agency. A state MEP organization would have a single mission. Commercial cleanup firms generally provide services in several related areas. Cleanup is often just a sideline business for those firms.

The Coast Guard and commercial firms are able to apply their resources to a variety of purposes. This multiple use

of resources can provide for more efficient use of those resources and, in that sense, is desirable. One of the reasons the Coast Guard was initially made responsible for marine envirnonmental protection was the physical presence of existing Coast Guard resources in the marine environment. [53,p.2] Commercial firms generally use a substantial portion of their resources (e.g., tugs, barges, pumps, and personnel) for other commercial purposes in addition to pollution response.

This multiple-use potential allows the application of resources to MEP activities on incremental cost basis. The resources already exist. Using those resources for MEP activities generates only variable costs. The costs of MEP functions are then a linear function of the number of spills that occur.

A state organization for MEP would not have the same advantage of multiple uses for its resources. Some common use of state resources can be expected, as has been previously mentioned. Generally, states do not have the personnel and equipment in the proper locations necessary to perform MEP functions at the present time. A state organization would have to procure personnel and equipment and locate them appriately to provide MEP services. The number of people and amount of equipment would have to be predicated on the expected number and location of spills.

Initially, the costs of a state MEP organization would be fixed costs, once the expected number and location of

spills were established. The costs would be a function of the organizational aspects and equipment lists of the state organization. Once those organizational aspects and equipment lists were set, the costs would also be set. The problem is that a wide range in the expected number of spills may not change personnel and equipment requirements. Such considerations as work weeks, personnel assignments, and readiness requirements become the overriding factors in cost estimation.

A hypothetical state MEP organization is presented in Appendix C for the State of Washington. This is presented as an example of the attributes and costs of a state MEP organization. It was constructed in accordance with the assumptions mentioned in the first part of this chapter. The hypothetical state organization was designed to respond to the number, sizes, and locations of spills that occurred in the State of Washington during the quarters considered in the data analysis in the previous chapter.

The cost of the hypothetical MEP organization in Washington is just over $1 million per year in 1974 dollars. Well over half of that total is personnel related cost (approximately $666,625 with overhead). The cost for Washington calculated in the previous chapter is only about $300,000, however. Part of the expense for the Portland area was in Washington. The difference results from the lack of multiple-purpose resources.

The simple truth is that there are not enough spills to be investigated or cleaned up. The performance standards and personnel availability considerations establish a minimum number of personnel needed for a state MEP organization. The equipment inventory is also tied to that number of personnel. The difference in the costs is the penalty for idle time and lack of use.

VI. FACTORS AFFECTING FUTURE MEP ACTIVITIES ON THE WEST COAST

If the grant-in-aid program were established, it would probably not result in effective state organizations before fiscal year 1977. Perhaps no major changes in amounts of petroleum transferred, vessel transits, or number of waterfront facilities handling petroleum will occur by then. There are, however, trends which may affect future MEP activities on the West Coast and nationwide. Long range planning necessitates a consideration of those trends and factors influencing them.

Among factors worthy of consideration due to their potential effects are the increasing construction of supertankers, the consequent need for deep water ports, the petroleum imports needed to fulfill increasing energy requirements, offshore drilling and the Alaskan pipeline. All these factors follow directly from the increasing U.S. demand for petroleum products.

Over the long term, the U.S. Department of Interior has predicted a 233% increase in petroleum consumption by the year 2000 over 1971 consumption levels: [71,p.18]

1971..........15.1	million barrels/day
1975..........17.4	" " "
1980..........20.9	" " "
1985..........25.0	" " "
2000..........35.6	" " "

Those figures were a 1972 estimate. Where that oil will come from is important. If it is to move over or near U.S. waters, some pollution incidents are inevitable. A state MEP organization should have adequate resources to respond to those incidents. Sources of U.S. petroleum supply are listed in table 3. The table shows that, while 74% of the 1971 supply came from domestic sources, only 16.9% of the supply will come from continental U.S. sources in the year 2000. 83.1% of the 12,985,000,000 barrels estimated consumption in the year 2000 will, probably, be transported over U.S. waters. Of course, the table shows estimates of consumption made before the energy crisis of 1973 and 1974.

If the present trend continues, tank vessels to carry that petroleum will become increasingly large.

> At the end of World War II, the average capacity of oil tankers approximated 20,000 deadweight. Since then, new tankers, termed Very Large Crude Carriers (VLCC's), have grown in size to over 500,000 deadweight tons, with drafts exceeding 90 feet and lengths of over 1200 feet. [2,p.4]

The growth of the petroleum-carrying ships and the relative sizes of those ships can be shown as follows: [2,p.5]

1. Queen liners: 40 foot draft.

2. Supertankers of early 1960's: 200,000 deadweight tons, 60 foot draft, and capacity for 1.4 million barrels of bulk cargo.

3. VLCC's: 326,000 deadweight tons, 75 foot draft, and capacity for 2.2 million barrels of bulk cargo.

EXHIBIT 3

1972 FORMULATION OF AN ESTIMATE PETROLEUM

SUPPLY SCHEDULE WITH ESTIMATED U.S. CONSUMPTION[1] [72,p.19]

	1971 ACTUAL	1975 EST.	1980 EST.	1985 EST.	2000 EST.
L SUPPLY					
llion barrels	5,523	6,340	7,615	9,140	12,985
ll barrels/day	15.1	17.4	20.8	25.0	35.5
STIC SUPPLY: wer 48					
llion barrels	4,117	4,000	3,740	3,345	2,200
ll barrels/day	11.3	11.0	10.2	9.2	6.0
KAN SUPPLY:					
llion barrels	-	-	550	730	1,295
ll barrels/day	-	-	1.5	2.0	3.5
AL DOMESTIC SUPPLY:					
illion barrels	4,117	4,000	4,290	4.255	3,860
ill barrels/day	11.3	11.0	11.7	11.7	10.5
ROLEUM CONSUMPTION:					
illion barrels	5,523	6,340	7,615	9.140	12,985
ill barrels/day	15.1	17.4	20.9	25.0	35.6
F COMSUMPTION SUP- LIED BY LOWER 48	75	63	49	37	17

Includes crude oil an natural gas liquids.

4. Super VLCC's, some of which are presently under construction: 1 million deadweight tons, 100 foot draft, and capacity for 7 million barrels of bulk cargo. Vessels of this size will require extensive changes in the port facilities of the United States. Only Puget Sound on the West Coast can now accommodate vessels of 100 foot draft, but nowhere could such a vessel use the conventional type of petroleum transfer terminal.

The giant tank vessels will also have a significant impact on more than just petroleum transfer facilities.

> Construction of deep water terminals will therefore not only generate new refinery activity in proximity to the terminal facility, but will also tend to induce the establishment of large petrochemical complexes in the same vicinity, especially if the region involved already has a high degree of industrialization." [2,p.7]

Other ports which do not develop VLCC capacity should also experience increases in petroleum cargoes due to transshipment in smaller tank vessels. These other ports probably will not experience the commensurate increase in ancillary facilities. The importance of these changes is their effect on spill potential.

Larger vessels are coming because they are cheaper to operate. Importing petroleum in a 250,000 ton tanker results in a $1.26 per barrel shipping cost, compare to a $.97 per barrel cost in a 500,000 ton tanker. [72,p.327] But, the

larger vessels may necessitate changes in pollution response activity and technology.

It is predicted that

> the use of supertankers and deep water ports would, by reducing the number of tankers arriving at existing U.S. ports, and thereby reducing the probability of collisions or groundings, reduce the number of oil spill accidents. The results of a Council of Environmental Quality study concluded that the use of supertankers and deep water ports would reduce spills to 10% of what they would be with the use of smaller ships (considering only the number of spills) [72,p.456]

That would be the eventual result of total conversion to supertanker use. That will not happen in the near future. It takes 2 to 3 years to build a tanker, and Congress has not yet passed the legislation authorizing construction of deep water ports. There will be, however, a steady trend to larger vessels as the new replace the old. The short term effect is difficult to predict. Past spill rates are used in this project, but future changes may effect the results.

One thing is certain, larger vessels will mean unprecedented pollution risks because of the potential for much larger spills. Present technology presents "no fully effective techniques for dealing with large oil spills." [13,p.8] It has been estimated that a massive spill from a 400,000 deadweight ton tanker 20 miles offshore Delaware could form a slick affecting states as far north as Massachusetts and inflicting damage totalling as much as $2,8 billion. [2,p.11]

The increased risk of a major spill inevitably has to be weighed against the potential for reduction in the number of spills. Approximately 500,000 barrels of petroleum were lost in tanker/terminal operations annually from 1969 to 1971. Over 7 million barrels were lost due to routine tanker operations and ballasting and cleaning of cargo tanks. [2,p.9] Present procedures and requirements have already had an effect of these amounts. Further reduction is necessary.

The effect of the Alaskan Pipeline will be easier to predict.

> Initial flow will be at the rate of 600,000 barrels a day. This will be stepped up over a period of 2 years to 2 million barels a day by adding more pumping stations. [28,p.46]

The oil from Alaska should, therefore, provide about 60% of the predicted West Coast demand for oil of 3.4 million barrels a day by 1980. [72,p.20]

Presently, it is planned that the oil from Alaska will be received in only the West Coast ports of Puget Sound, San Francisco, and Los Angeles/Long Beach. [28,p.46] Of course, there may be drastic differences between the predictions and the actual events. Though it has been predicted that U.S. dependence on imported oil will increase greatly, a recent Federal Energy Administration "blueprint for Project Independence says the United States could eliminate all oil imports by 1985 if world oil prices remain high." [46,p.16] Predictions notwithstanding, it is safe to assume that few changes in the present trends will be realized before 1977.

Some of the possible short term effects of the present trends were noted during a review of the data gathered from West Coast areas. Factors that may have an efect are as follows:

1. It was noted that, generally, areas with large petroleum handling facilities that receive from or dispense to large tank ships had fewer spills per ton of petroleum handled than areas with smaller facilities. This is apparently due to the fact that much of the spill danger occurs at the coupling and uncoupling. Once those operations are complete, large amounts of petroleum may be delivered with relative safety. This is probably why the regression studies did not find the volume of petroleum transferred to be a significant predictor of the number of spills occurring. The number of tank vessels transits and number of petroleum handling facilities provide a better indication of the number of couplings and uncouplings.

2. Only about one spill in four is presently cleaned up by either the spiller or the Coast Guard. This ratio is decreasing and may reach one in three as more equipment becomes available and the impetus to cleanup increases. Less industrialized ports have less equipment available now. That is one reason why there were more cleanups in which the Coast Guard participated actively at the smaller ports relative to the size of the port areas. Also, at larger ports, the investigators are more experienced and find the source of the spill more often. That results in smaller spills (the source

being discovered more quickly and action taken to stop spillage) and more cleanups being performed by the responsible party.

3. Small ports are receiving less petroleum by water. Companies that used to barge fuel oil for private use now find that Coast Guard regulations are causing higher costs and requiring greater personnel time. These companies are opting for other means of supply. Thus, the number of facilities submitting letters of intent to operate petroleum handling facilities is becoming a more accurate listing of those facilities with regular petroleum handling operations.

4. The size of individual spills depends on other factors such as the size of the vessel and the experience of the personnel involved. This is a reason why none of the data was found to be a good predictor of spill volume in an area. The size of the spills relates to the number of manhours spent in cleanup. Availability of commercial equipment, skill of investigators, and other factors then become important in predicting the number of man-hours that will be spent in an area on cleanup activities. That is a reason why none of the data was a good predictor of man-hours spent in cleanups.

5. Many spills occur from non-transportation related waterfront facilities. These facilities do not have to submit letters of intent to the Coast Guard. The location of spills from these sources is harder to predict.

Large petroleum operations will be located in or near areas of significant commercial development. In areas of the country other than the West Coast, however, the proportion of facilities required to submit letters of intent may be substantially different. Minor modifications to the coefficients of the regression equations may be all that is necessary. On the other hand, the basic relationships exhibited in the regression equations may not apply at all to other areas. Tests should be performed to determine the applicability of the equations in different port areas.

VII. CONCLUSIONS

As with many projects, more questions have been raised than have been answered by this project. Additional research and analysis on this subject is necessary to achieve a more complete understanding of causes and effects in the marine environment. Then, too, this project has led the author to some conclusions concerning Marine Environmental Protection activities.

There appears to be a need for additional study and statistical analyses. Relating program costs, personnel considerations, and response levels to various environmental variables should prove beneficial. There is a basic relationship between the number of spills and the amounts of petroleum transferred, the number of vessel transits and the number of waterfront facilities handling petroleum. Understanding the exact nature of this relationship and how other factors influence it could provide important information. Programs could concentrate on those factors that give the greatest positive results. More effective resource allocations could be made.

The formulas resulting from the data analyses are a beginning. They can be used as a basis for resource allocation or for cost prediction, with some future refinement. They also provide a basis for fund allocation for the grant-in-aid program. Under the assumptions regarding a state program made

herein, the costs should not exceed the calculated cost. That should be a maximum if the program is to maintain its present cost-effectiveness. The single purpose character of a state MEP organization will probably dictate highter costs.

There are intangible benefits to be gained by having the states assume MEP functions. Some of these benefits were mentioned when grants-in-aid background was discussed. Revising the assumptions or changing the criteria for state MEP performance may allow state costs to be reduced. The assumptions were reasonable given the initial objectives of this study and the existing circumstances of marine environmental protection. Changes in the criteria for performance of MEP functions could result, however, from an overall review of the goals and objectives of MEP.

One would hope that the grant-in-aid program, if established, would remain true to the objectives of MEP established in national legislation. There are other influencing factors, though. Some consideration should be given to the economic externalities of such a program. Who is benefitting, and who is paying? Political factors must be considered. The economic cost of environmental degradation is relevant. An effective means of fund allocation should relate the amount of the individual grant to the benefits to be achieved.

There are problems involved in states' assumption of MEP duties. States have multiple objectives. Program priorities differ. A grant-in-aid program alters these priorities. Are

the states willing to have their priorities altered? What federal funding level is necessary to induce participation? Some states have been very active in the Marine Environmental Protection field. Washington, for example, has an ambitious program It concentrates, however, on prevention and planning. The Washington Department of Ecology has authority to contract for spill removal and does use that authority. It does not now plan to expand its program in that area.

Implementing the grant-in-aid program would require revising many states' laws. These costs have not been considered herein, but they are real and relevant. Then there is the problem with the states that aggressively prosecute polluters. Would those states want to forward cases to the Coast Guard for legal action? Those problems affect the funding level needed for inducement to participate.

Conversations with various states' officials have indicated that there is a general reluctance on the part of these officials to see their states involved in this type of program. Their agencies are now primarily administrative, and they like it that way. Operational programs require greater costs and greater numbers of personnel. Cost estimating is much more difficult for an operational program than it is for an administrative program. Cutbacks are harder to make.

The conversations with the states' officials have lead to the conclusion that the states would not consider participation unless federal funds financed a majority of the costs.

This would mean 75% to 90% funding in most instances. Some states (Nevada, for instance) would need 90% to 100% federal financing to induce their participation.

Before the grant-in-aid program is activated, the states' reluctance should receive special attention. Further study is also needed on more cost-effective means to achieve the objectives of the Marine Environmental Protection program and those of the new Federalism.

Local and state land use planning may also prove effective in pollution abatement and cleanup. Coast Guard participation in this planning could produce requirements for local spill response capabilities before an industry is allowed to operate on or near the water. The more the private firms can be induced to respond to spills, the more effective the MEP program can become.

Finally, the material presented herein should be reviewed and refined. The assumptions should be examined. The effect of modifications should be analyzed. More and better data are necessary. Other states in other areas of the country should be used as tests of the accuracy and appropriateness of the costs determined herein.

Some of the relationships found through analyses of the 11th, 12th and 13th Coast Guard Districts' data may not hold in other areas of the country. The West Coast is somewhat unique geographically. Different geography and other differences may invalidate the basic nature of the relationships

described in the regression formulas. The number of waterfront facilities that have submitted letters of intent to engage in the transfer of petroleum products may not be a predictor of the number of spills occurring in other areas. Riverine areas may have a substantially different ratio of those facilities to all waterfront facilities. That fact may alter the nature of the relationship with spills. If, however, those relationships are tested and found to hold nationwide, they would then provide an indication of specific costs and the overall size of a grant-in-aid program. Until the relationships are tested, no such estimates of total program size can be made.

This study does provide a basis from which further studies can be made. Objectives and assumptions have been carefully established. The responsibilities of the U.S. Coast Guard in Marine Environmental Protection have been used as a background against which the grant-in-aid concept has been applied.

The factors which are important in planning a grant-in-aid program have been outlined. Trends have been considered with emphasis on changes in the basic sources and causes of pollution incidents. Information relevant to this planning has been gathered, sorted, reviewed and analyzed.

Commercial firms and cooperatives provide the most efficient means of cleanup activity from a cost standpoint. Equipment and people are paid for only when they are used. The commercial enterprises are able to maintain this response

capability, since they have alternate uses and needs for the manpower and equipment.

Rather than compete with commercial firms, the Coast Guard should encourage their participation in pollution response efforts. One way to do this and to increase states' participation at the same time would be to relax the standards for reimbursement from the federal Revolving Fund for pollution cleanup. The states could contract with commercial firms for cleanup and then be reimbursed. This might be sufficient inducement to increase state participation. They would gain control of federally financed cleanups in their own state.

Investigation is a different matter. Increased training and more experienced personnel are necessary. This is true for both the Coast Guard and the states. States such as Nevada have few if any pollution-response trained personnel. MEP program effectiveness depends on the experise of local operating forces. Intergovernmental cooperation to develop that expertise is important. A grant-in-aid program aimed at this objective might be most beneficial.

APPENDIX A

LISTS OF PETROLEUM HANDLING WATERFRONT ACTIVITIES

This appendix contains lists of all those petroleum handling facilities in the 11th, 12th , and 13th Coast Guard Districts that have submitted letters of intent to operate oil transfer facilities in accordance with section 154.110, subchapter 0 of Title 33, Code of Federal Regulations.

These lists were provided by local Captain of the Port Offices in those Coast Guard Districts. The lists show each facility's name and location. Concord area facilities are included with San Francisco area facilities since the letters of intent for the Concord area are Submitted to the Captain of the Port San Francisco in accordance with federal regulations.

EXHIBIT A.1.

SEATTLE AREA

1. Alaska Packers Ass'n	Blaine, Wa.
2. American Smelting & Refining	Tacoma, Wa.
3. Arco	Bellingham, Wa.
4. Arco	Bremerton, Wa.
5. Arco	Cherry Pt., Wa.
6. Arco	Olympia, Wa.
7. Arco	Port Angeles, Wa.
8. Arco	Pier 11, Seattle, Wa.
9. Ballard Oil Co. (Shell)	Seattle, Wa.
10. Blakely Marina	Blakely Is., Wa.
11. Bremerton Oil co.	Bremerton, Wa.
12, Buckeye Pipeline	Tacoma, Wa.
13. Chemical Processors	Seattle, Wa.
14. Columbia Sement	Bellingham, Wa.
15. Crosby & Overton Inc.	Bellingham, Wa.
16. Crosby & Overton Inc.	Seattle, Wa.
17. Crown Zellerback	Port Angeles, Wa.
18. Crown Zellerback	Port Townsend, Wa.
19. Dailey Petroleum (texaco)	Port Angeles, Wa.
20. Fletcher Oil	Tacoma, Wa.
21. Foss Launch & Tug	Seattle, Wa.
22. Georgia Pacific	Bellingham, Wa.
23. Hooker Chemical	Tacoma, Wa.
24. Inland Trans. Co.	Seattle, Wa.

25. Lents Co.	Bremerton, Wa.
26. Liquid Waste Disposal	Seattle, Wa.
27. Lofthus Oil	Bremerton, Wa.
28. Milwaukie Docks	Tacoma, Wa.
29. Mobil Oil	Ballard, Wa.
30. Mobil Oil	Ferndale, Wa.
31. Mobil Oil-Mobil Fac.	Seattle, Wa.
32. Mobil Oil	Pier 15, Seattle, Wa.
33. Mobil Oil	Tacoma, Seattle, Wa.
34. MOPS	Seattle, Wa.
35. Northwest Petro.	Tacoma, Wa.
36. Pac-Mar	Seattle, Wa.
37. Penwalt Chemical	Tacoma, Wa.
38. Phillips Oil	Bremerton, Wa.
39. Phillips Oil	Port Angeles, Wa.
40. Phillips Oil	Pier 34, Seattle, Wa.
41. Quendall Terminal	Renton, Wa.
42. Rayonier Wharf	Port Angeles, Wa.
43. Saco Oil	Port Orchard, Wa.
44. Scott Paper co.	Everett, Wa.
45. Seattle Steam	Pier 57, Seattle, Wa.
46. Shell Oil	Anacortes, Wa.
47. Shell Oil	Pier 19, Seattle, Wa.

48.	Shell Mobil Facility	Seattle, Wa.
49.	Shell Mobil Facility	Tacoma, Wa.
50.	Shell Mobil Facility	Port Townsend, Wa.
51.	Soco (Chevron)	Anacortes, Wa.
52.	Soco (Chevron)	Bellingham, Wa.
53.	Soco (Chevron)	Blaine, Wa.
54.	Soco (Chevron)	Bremerton, Wa.
55.	Soco (Chevron)	East Sound, Orcas Is., Wa.
56.	Soco (Chevron)	Friday Harbor, Wa.
57.	Soco (Chevron)	Gig Harbor, Wa.
58.	Soco (Chevron)	Seattle, Wa.
59.	Soco (Chevron)	Langley, Wa.
60.	Soco (Chevron)	Neah Bay, Wa.
61.	Soco (Chevron)	Oak Harbor, Wa.
62.	Soco (Chevron)	Olympia, Wa.
63.	Soco (Chevron)	Point Wells, Wa.
64.	Soco (Chevron)	Port Angeles, Wa.
65.	Soco (Chevron)	Port Townsend, Wa.
66.	Soco (Chevron)	Portage, Wa.
67.	Soco OChevron)	Poulsbo, Wa.
68.	Soco (Chevron)	Richardsons Store, Wa.
69.	Soco (Chevron)	San de Fuca, Wa.
70.	Soco (Chevron)	Shelton, Wa.

SEATTLE AREA
cont.

71.	Soco (Chevron)	Tacoma, Wa.
72.	Soco (Chevron)	Vashon Is., Wa.
73.	Soco (Chevron)	Wisnlow, Wa.
74.	Sound Refinery	Tacoma, Wa.
75.	St. Regis Paper Co.	Tacoma, Wa.
76.	Texaco Refinery	Anacortes, Wa.
77.	Texaco Refinery (Dailey Petro)	Port Angeles, Wa.
78.	Texaco Refinery (Dailey Petro)	Pier 15, Seattle, Wa.
79.	Thomas Oil Co.	Port Townsend, Wa.
80.	Time Oil	Bellingham, Wa.
81.	Time Oil	Seattle, Wa.
82.	Time Oil	Ballard, Wa.
83.	Todd Shipyard	Seattle, Wa.
84.	Union Oil	Edmonds, Wa.
85.	Union Oil	Fishermans Term, Seattle, Wa.
86.	Union Oil	Friday Harbor, Wa.
87.	Union Oil	Orcas Is., Wa.
88.	Union Oil	Pier 71, Seattle, Wa.
89.	Union Oil	Tacoma, Wa.
90.	U.S. Oil & Refinery	Tacoma, Wa.
91.	West Waterway Lumber	Seattle, Wa.
92.	Western Tank Lines	Richmond Beach, Wa.
93.	Weyerhauser Kraft Mill	Everett, Wa.

94.	Wholesale Marine Consigner	Seattle, Wa.
95.	Wilkins	Port Orchard, Wa.
96.	Wycoff	Seattle, Wa.
97.	Wycoff Co.	Winslow, Wa.

EXHIBIT A.2.

PORTLAND AREA

1.	American Ship Dismantlers (Schnitzer)	Portland, Or.
2.	Arco	Portland, Or.
3.	Koppers Company, Inc.	Portland, Or.
4.	Mc Call Oil Co.	Portland, Or.
5.	McCormick & Baxter	Portland, Or.
6.	Mobil Oil Corp.	Portland, Or.
7.	Pacific Power & Light (Lincoln Plant)	Portland, Or.
8.	Pacific Power & Light (Pasco Dock)	Portland, Or.
9.	Pacific Molasses	Portland, Or.
10.	Palmco, Inc.	Portland, Or.
11.	Pennwalt Corp.	Portland, Or.
12.	Portland General Electric Co. Harborton	Portland, Or.
13.	Porltand General Electric Co. Station L.	Portland, Or.
14.	Phillips Petro. Co.	Portland, Or.
15.	Shell Oil Co.	Portland, Or.
16.	Standard Oil Co. (Terminal #4)	Portland, Or.
17.	Standard Oil Co. (Willbridge Plant)	Portland, Or.
18.	Swan Is. Ship Repair Yard	Portland, Or.
19.	Texaco Oil	Portland, Or.
20.	Time Oil Co.	Portland, Or.
21.	Union Oil Co.	Portland, Or.
22.	Zidell's Exploration, Inc.	Portland, Or.

PORTLAND AREA
cont.

23. Boise Cascade Paper	Vancouver, Wa.
24. Burmah Terminals, Inc.	Vancouver, Wa.
25. Fletcher Oil Co.	Vancouver, Wa.
26. FMC	Vancouver, Wa.
27. Pacific Supply Coop	Vancouver, Wa.
28. Crown Zellerback	Camas, Wa.
29. Publisher Paper Co.	Oregon City, Or.
30. Crown Zellerbach Corp.	West Linn, Or.
31. Oregon/Portland Cement	Lake Oswego, Or.
32. Boise Cascade Pater	St. Helens, Or.
33. Crown Zellerbach Corp.	Clatskanie, Or.
34. Reichhold Chemical	St. Helens, Or.
35. Portland General Electric	Clatskanie, Or.
36. Standard Oil Terminal	Astoria, Or.
37. Standard Oil (Port Docks)	Astoria, Or.
38. Union Oil Co.	Astoria, Or.
39. Port of Longview	Longview, Wa.
40. Longview Fibre	Longview, Wa.
41. Standard Oil	Longview, Wa.
42. Weyerhaeuser Salt Dock	Longview, Wa.
43. Weyerhaeuser Wood Products	Longview, Wa.
44. Kalama Chemical Co.	Kalama, Wa.
45. ITT Rayonier	Grays Harbor, Wa.

PORTLAND AREA
cont.

46. Standard Oil	Grays Harbor, Wa.
47. Union Oil/Bay City Fuel	Grays Harbor, Wa.
48. PAC	Tri-Cities, Wa.
49. Standard	Tri-Cities, Wa.
50. Tidewater	Paco. Wa.
51. Tidewater	Umatilla, Or.
52. Chambers Fuel Co.	Coos Bay, Or.
53. Oregon Coast Towing	Coos Bay, Or.
54. Oregon Coast Towing	North Bend, Or.
55. Standard	Coos Bay, Or.
56. Texaco	Coos Bay, Or.
57. Union	Coos Bay, Or.
58. International Paper Co.	Gardiner, Or.
59. Georgia Pacific	Toledo, Or.
60. Albina Engine & Machine	Portland, Or.
61. Crosby & Overton	Portland, Or.
62. Hughes Oil Co.	Portland, Or.
63. Norhtwest Marine Iron Works	Portland, Or.
64. Shell Oil Co.	Portland, Or.
65. Standard Oil Co.	Portland, Or.
66. Widing Transportation	Portland, Or.
67. Wilson Oil Co.	Longview, Wa.
68. Empire Fuel Co.	Coos Bay, Or.

EXHIBIT A.3.

SAN FRANCISCO AREA

1.	Bethlehem Steel Corp.	San Francisco, Ca.
2.	Mobil Oil Corp.	San Francisco, Ca.
3.	Atlantic Richfield Co.	Milpitas, Ca.
4.	Pacific Gas & Electric Co.	San Francisco, Ca.
5.	Standard Oil Co. of Calif.	San Jose, Ca.
6.	Shell Oil Co.	San Francisco, Ca.
7.	Texaco, Inc.	Redwood City, Ca.
8.	Kaiser Cement ¢ Gypsum Corp.	Redwood City, Ca.
9.	Podesta Marine Service	Daly City, Ca.
10.	H & H Ship Service	San Francisco, Ca.
11.	Standard Oil Truck	San Jose, Ca.
12.	Kaiser	San Francisco, Ca.
13.	Triple A	San Francisco, Ca.
14.	Pennzoil Co.	Alameda, Ca.
15.	Harbor Tug ¢ Barge Co.	Alameda, Ca.
16.	Mobil Oil Corp.	Oakland, Ca.
17.	Pacific Dry Dock & Repair Co.	Oakland, Ca.
18.	Merritt Ship Repair Co.	Oakland, Ca.
19.	Shell Oil Co.	Oakland, Ca.
20.	Atlantic Richfield Co.	Richmond, Ca.
21.	Bay Terminals	Pt. Richmond, Ca. Richmond, Ca.
22.	Levin Metals Corp.	Richmond, Ca. Daly City, Ca.

SAN FRANCISCO AREA
cont.

23.	PVO International, Inc.	Richmond, Ca.
24.	Standard Oil Co. of Calif.	Richmond, Ca.
25.	Time Oil Co.	Richmond, Ca.
26.	Union Oil Co. of Calif.	Richmond, Ca.
27.	Texaco. Inc.	Richmond, Ca.
28.	Nicolai Joffe Corp.	Richmond, Ca.
29.	Fore Terminal, Inc.	Alameda, Ca.
30.	Petromark, Inc.	Richmond, Ca.
31.	Richmond Terminal Agency	Richmond, Ca.
32.	ACME Transportation Inc.	San Pablo, Ca.
33.	Willamette Iron & Steel Co.	Richmond, Ca.
34.	Del Chemical ¢ Supply Co.	Berkeley, Ca.
35.	Bray Oil Co.	Richmond, Ca.
36.	Puims Trucking	Richmond, Ca.
37.	Holland Oil	Richmond, Ca.
38.	Todd Shipyard	Alameda, Ca.
39.	Fabian Oil	Oakland, Ca.

THE FOLLOWING ARE IN THE CONCORD SUBAREA:

40.	Dow Chemical U.S.A.	Pittsburgh, Ca.
41.	Industrial Tank Inc.	Martinez, Ca.
42.	Crown Zellerback	Antioch, Ca.
43.	Exxon Co.	Benicia, Ca.
44.	Fibrboard Corp.	Antioch, Ca.
45.	Pacific Gas & Electric Co.	Antioch, Ca.

SAN FRANCISCO AREA
cont.

46. Pacific Gas ¢ Electric Co.	Pittsburgh, Ca.
47. Phillips Petroleum Co.	Martinez, Ca.
48. Sheldon Oil Co.	Suisun, Ca.
49. Union Oil Co. of Calif.	Rodeo, Ca.
50. Sequoia Refining Corp.	Hercules, Ca.
51. Shell Oil Co.	Martinez, Ca.
52. Holly Corp.	Martinez, Ca.
53. Urich Oil	Martinez, Ca.
54. Atlantic Richfield Co.	Stockton, Ca.
55. Burmah Oil ¢ Gas Co.	Stockton, Ca.
56. Time Oil Co.	Stockton, Ca.
57. Texaco, Inc.	Stockton, Ca.
58. Southern Pacific Pipe Line	Stockton, Ca.
59. Phillips Oil	Stockton, Ca.
60. Union Oil	Stockton, Ca.
61. Atlantic Richfield Co.	West Sacramento, Ca.
62. Phillips Petroleum Co.	Sacramento, Ca.
63. Burmah Oil & Gas Co.	West Sacramento, Ca.
64. Time Oil Co.	Sacramento, Ca.
65. Standard Oil Co. Of Calif.	Sacramento, Ca.

EXHIBIT A.4.

MONTEREY AREA

1. PGE	Moss Landing Estero Bay
2. Union	Estero Bay
3. Standard	Estero Bay
4. Texaco	Estero Bay
5. U.S. Navy	Estero Bay
6. Mobil Oil	Monterey Estero Bay

EXHIBIT A.5.

HUMBOLDT BAY AREA

1. Shell Oil Co.	Eureka, Ca.
2. Standard Oil Co.	Eureka, Ca.
3. Union Oil Co.	Eureka, Ca.
4. Crown Simpson Pulp Co.	Eureka, Ca.
5. Oil Terminals Co.	Eureka, Ca.
6. Pacific Gas & Electric Co.	Eureka, Ca.
7. Oil Terminals Co.	Crescent City, Ca.

EXHIBIT A.6.

LOS ANGELES/LONG BEACH AREA

1.	Standar Oil Co.	Carpenteria, Ca.
2.	Texaco, Inc.	Long Beach, Ca.
3.	Southern Calif. Edison Co.	Ventura, Ca.
4.	National Molasses Co.	Long Beach, Ca.
5.	Standard Oil Co. of Calif.	El Segundo, Ca.
6.	Pennzoil Co.	Los Angeles, Ca.
7.	Mobil Oil Corp.	Los Angeles, Ca.
8.	Arco	Long Beach, Ca.
9.	Mobil Oil Corp.	Los Angeles, Ca.
10.	Standard Oil Co. of Calif.	Long Beach, Ca.
11.	Union Oil Co.	Los Angeles, Ca.
12.	Shell Oil Co.	Long Beach, Ca.
13.	Signal Oil & Gas Co.	Los Angeles, Ca.
14.	Getty Oil Co.	Gaviota, Ca.
15.	Getty Oil Co.	Ventura, Ca.
16.	Gulf Oil	Huntington Beach, Ca.
17.	Union Oil	Ventura, Ca.
18.	Union Oil	Cojo Bay, Ca.
19.	Arco	Long Beach, Ca.
20.	Chevron Chemical Co.	Los Angeles, Ca.
21.	CONOCO	Los Angeles, Ca.
22.	L.A. Dept of Water & Power	Los Angeles, Ca.
23.	Edgington Oil Co.	Los Angeles, Ca.

LOS ANGELES/LONG BEACH AREA
cont.

24.	GATX Chemicals	Los Angeles, Ca.
25.	Exxon	Long Beach, Ca.
26.	Golden Eagle Oil Co.	Los Angeles, Ca.
27.	Gulf Oil Co.	Los Angeles, Ca.
28.	Mobil Oil Corp.	Los Angeles, Ca.
29.	Phillips Petroleum	Los Angeles, Ca.
30.	Powerine Oil Co.	Long Beach, Ca.
31.	Proctor & Gamble	Long Beach, Ca.
32.	Shell Oil	Los Angeles, Ca.
33.	Standard Oil	Los Angeles, Ca.
34.	Time Oil Co.	Los Angeles, Ca.
35.	Union Oil Co.	Los Angeles, Ca.
36.	Union Oil Co.	Los Angeles, Ca.
37.	U.S. Naval Fuel Depot	Los Angeles, Ca.
38.	West Oil Terminals Co.	Los Angeles, Ca.
39.	Arco	Long Beach, Ca.

EXHIBIT A.7.

SAN DIEGO AREA

1.	Phillips	San Diego, Ca.
2.	Union Oil	San Diego, Ca.
3.	Standard Oil Co.	San Diego, Ca.
4.	Navy Fuel Pier	San Diego, Ca.
5.	Mobil Oil Co.	San Diego, Ca.
6.	Shell Oil Co.	San Diego, Ca.
7.	Capitol Truck Lines	San Diego, Ca.
8.	Exclusive Transportation Corp.	San Diego, Ca.
9.	Pepper Tank Co.	San Diego, Ca.
10.	Marina Cortez	San Diego, Ca.
11.	San Diego Gas And Electric Co.	San Diego, Ca.
12.	San Diego Gas And Electric Co.	Encina, Ca.
13.	Oldfield Trucking Co.	San Diego, Ca.
14.	Arco	San Diego, Ca.
15.	Standard Oil Co.	Embarcadero, Ca.

APPENDIX B

DATA USED IN ANALYSES

This appendix contains the data pertaining to MEP activities in the 11th, 12th, and 13th Coast Guard Districts and are the inputs to the analyses performed.

EXHIBIT B.1.

LOCATIONS ON THE PACIFIC COAST THROUGH WHICH SIGNIFICANT AMOUNTS OF WATERBORNE PETROLEUM PRODUCTS ARE TRANSPORTED

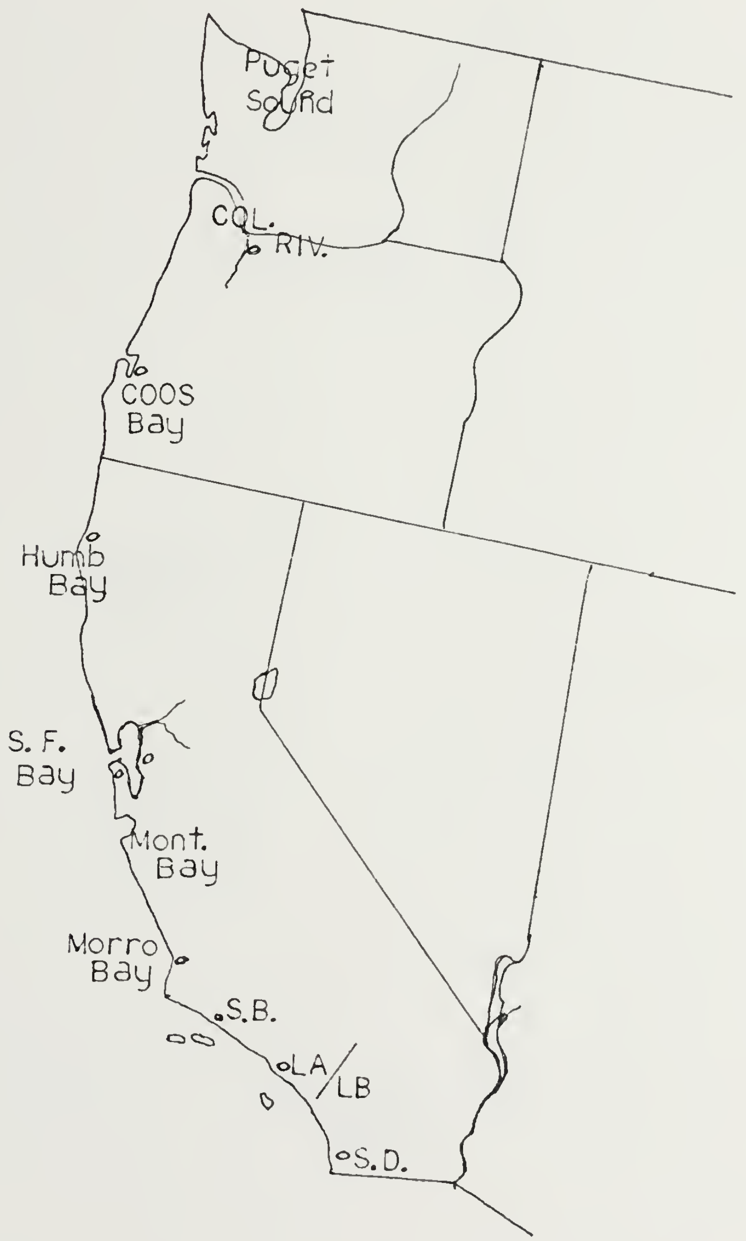

EXHIBIT B.2.

ZONES OF RESPONSIBILITY
U.S. COAST GUARD CAPTAINS OF THE PORT [ref.4]

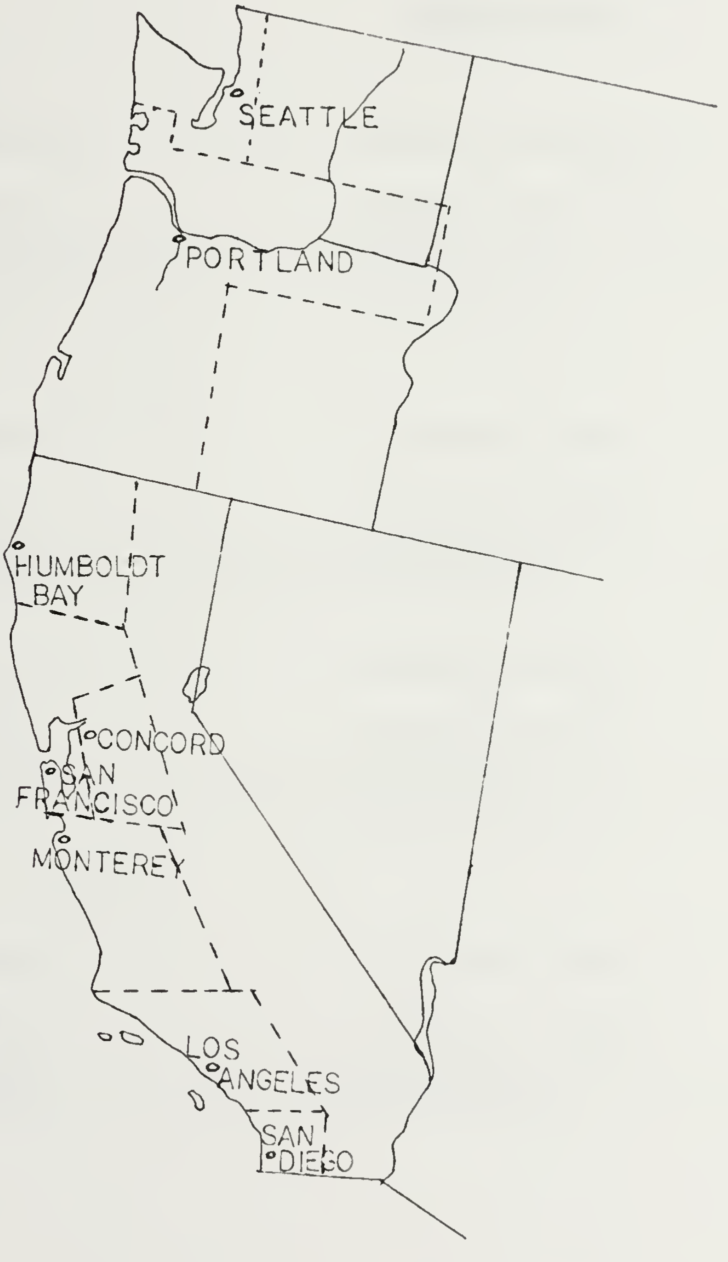

EXHIBIT B.3.

WATERBORNE PETROLEUM DATA
FROM PORT SAFETY/MARINE
ENVIRONMENTAL PROTECTION ACTIVITIES
REPORTS [ref.67]

		TRANSPORTED	SPILLED
Petroleum-			
2/74	Portland	8,139,336 bbls	572 bbls
	Seattle	25,1000,000 bbls	1,237 bbls
	Total	33,239,336	1,809
Petroleum-			
1/74	Portland	9,326,041 bbls	1,941 bbls
	Seattle	20,467,829 bbls	680 bbls
	Total	29,793,870	1,721
4/73	Portland	10,662,463 bbls	134 bbls
	Seattle	61,354,488 bbls	1,081 bbls
	Total	72,016,951	1,215
Petroleum products-			
Ave.	Portland	9,375,947 bbls	582 bbls
	Seattle	35,640,077 bbls	999 bbls
	Total	45,016,024	1,581

PETROLEUM PRODUCTS-barrels cont.

		TRANSPORTED	SPILLED	
2/74	Concord	30,050,915	201	
	MSO S.F.	35,000,000	25	
	Monterey	11,050,850	2,000	
	Humboldt Bay	749,623	31	
	LA/LB	101,750,000	1,017	
	San Diego	1,095,000	46	
	Santa Barbara	Unk.	Unk.	
	Totals	179,696,388	3,320	
1/74	Concord	36,323,000	5	
	MSO S.F.	35,000,000	78	
	Monterey	10,613,208	13	
	Humboldt Bay	323,651	19	
	LA/LB	102,500,000	602	
	San Diego	1,780,000	500	
	Santa Barbara	Unk.	932	(not incl. in total)
		186,539,859	2,147	
4/73	Concord	38,330,000	27	
	MSO S.F.	35,000,000	198	
	Monterey	4,784,547	5	
	Humboldt Bay	850,000	5	
	LA/LB	105,000,000	985	
	San Diego	1,015,000	334	

PETROLEUM PRODUCTS-cont.

		TRANSPORTED	SPILLED
4/73	Santa Barbara	Unk.	76 (not incl. in total)
		184,979,547	1,554
AVE.	Concord	34,901,302	78
	MSO S.F.	35,000,000	100
	Monterey	8,816,197	673
	Humboldt Bay	641,191	18
	LA/LB	103,833,333	868
	San Diego	1,396,667	293
	Santa Barbara	-	-
	Totals	184,488,590	2,030

EXHIBIT B.4.

U.S. ARMY CORPS OF ENGINEER'S DATA
ON
WATERBORNE PETROLEUM-WEST COAST
(000 TONS) [ref.15]

AREA	1971	1972	1973 (2)	REMARKS (1)
San Diego	751	693	648	
Long Beach	13,159	12,193	16,015	Up 100%- 10 yrs.
Los Angeles	16,871	16,603	16,303	Up 15%- 10 yrs.
Port Hueneme	27	96		
Carpinteria	490	529		
El Segundo	4,696	5,669		
Encina	277	308		
Estero Bay	3,390	4,025		
Huntington Beach	310	299		
San Luis Obispo	1,286	1,393		
Ventura	3,607	2,353		
Suisun Bay Channel	5,345	3,248		Down 30%- 10 yrs. 30 ft. Chan.
Sacramento	214	212		Decreasing
Stockton	1,071	707		Steady
Moss Lnading	254	272		
San Francisco	449	615		Down 50%- 10 yrs.
Redwood City	257	346		Down 70%- 10 yrs.
Oakland	926	1,117		Up 25%- 10 yrs.
Richmond	11,535	14,271		Down 18%- 10 yrs.
San Paulo/ Marc Is.	20,772	21,369		Up 35%- 10 yrs.

U.S. ARMY CORPS OF ENGINEER'S DATA
(cont)

AREA	1971	1972	1973	REMARKS[1]
Humboldt Bay	318	363		Up 275%- 10 yrs.
Crescent City	255	269		Down 33%- 10 yrs.
Other S.F. Bay Ports	1,151	1,317		
Kennewick/Pasco	452	705	1,100	
Astoria	59	67	70	Up 75%- 10 yrs.
Longview	243	213	245	Up 70%-10 yrs.
Kalama	14	51	2	Up 350%- 10 yrs.
Vancouver, Wa.	142	180	219	Up 60%- 10 yrs.
Portland	5,140	5,644	5,980	Up 15%- 10 yrs.
Coos Bay	288	300	320	Up 200%- 10 yrs.
Umpqua R.	57	62	57	Down 20%-10 yrs.
Yaquina R.	21	12	12	Down 50%- 10 yrs.
Grays Harbor	162	193		Up 100%- 10 yrs.
Port Angeles	214	193		
Port Townsend	43	50		
Olympia	119	102		Up 25%- 10 yrs.
Tacoma	1,827	1,550		Up 33%- 10 yrs.
Seattle	4,859	4,887	5.147	
Everett	62	46		
Anacortes	1,126	2,696		
Bellingham	53	324		

U.S. ARMY CORPS OF ENGINEER'S DATA
(cont)

AREA	1971	1972	1973	REMARKS[1]
Other Puget Sound Ports	1,979	4,519		
Totals	104,271	110,061		

(1) These trends are for total waterborne commerce and may not indicate precisely the bulk petroleum trends.

(2) These figures obtained from Port Authorities and include only petroleum handled at their facilities, complete 1973 data were not available when this was prepared.

EXHIBIT B.5.

SPILL RATES PER TON OF
WATERBORNE PETROLEUM[1]

AREA	TONS TRANSPORTED PER SPILL INVESTIGATION	GALLONS SPILLED PER TON TRANSPORTED
Seattle	13,608	.017
Portland	23,432	.007
San Diego	2,707	.011
LA/LB	75,990	.002
Concord	122,031	.0006
S.F. Harbor	37,655	.0007
Monterey	226,051	.02
Humboldt Bay	8,965	.007
Overall[2]	38,588	.004

(1) Figures obtained from U.S. Coast Guard PS/MEP Activities Reports for 5th quarter 1973, 1st and 2nd quarters of 1974.

(2) This compares to 1 investigation per 59,471 tons transported, .01 gallons spilled per ton transported over waters of the West Coast states for 1971, 1972 based on U.S. Coast Guard spill data and U.S. Army Corps of Engineer's Shipping statistics.

EXHIBIT B.6.

VESSEL TRANSITS THROUGH COAST GUARD UNITS' AREAS FROM U.S. ARMY CORPS OF ENGINEERS WATERBORNE COMMERCE DATA [refs. 15]

	1970	1971	1972	1973	Total	Average per Quarter
San Diego	190	228	175	204	797	50
LA/LB	9,203	9,047	7,873	9,610	35,733	2,233
Monterey	463	448	443	439	1,793	112
Concord	2,263	2,321	2,304	1,851	8,739	546
S.F.	8,407	8,582	6,658	5,921	24,168	1,511
H. Bay	399	371	341	318	1,429	89
Portland	7,236	6,738	6,659	7,695	28,328	1,771
Seattle	8,171	7,759	8.976	8,668	33,574	2,098

EXHIBIT B.7.

OIL SPILL
REMOVALS BY ANY PARTY
FROM CG REPORTS [refs.67]

CG Unit	QUARTER 4/73	1/74	2/74	Ave.
Seattle	22	30	34	29
Portland	22	29	24	25
Concord	7	6	7	7
San Francisco	38	19	102	53
Monterey	0	4	2	2
Humboldt Bay	4	3	2	3
Los Angeles/ Long Beach	50	73	101	75
San Diego	14	52	51	39
Totals	157	216	323	232*

*Difference due to rounding

EXHIBIT B.8.

TWELFTH COAST GUARD DISTRICT
OIL SPILL ACTION

	1971	1972	1973
Total Spills Reported	386	454	676
Estimated Amount Spilled (gallons)	909,000	19,300	191,000
Spills Cleaned Up	72	177	248
By Coast Guard	05	25	71
By Spiller	67	152	177

REVOLVING FUND

	1971	1972	1973
EXPENDED	$1219.27	$13,737.05	$1,433,723.61*
cases	1	7	41
Reimbursed	$1219.27	$6,227.90	$33,869.53
Cases	1	3	7

*INCLUDES OAKLAND Estuary Spill(19 JAN To 26 JAN 1973)Clean up cost of: $1,241,822.66)

EXHIBIT B.9.

THIRTEENTH COAST GUARD DISTRICT

OIL SPILL ACTION

	1971	1972	1973
Reported	554	585	1307
Sources	290	319	839
nt Spilled (GALS)		75,000	100,000
REVOLVING FUND	(FISCAL YEAR)		
up Required	7	9	50
	$3,198.99	$10,622.00	$100,000.00 (Est.)
	$2,739.00	$ 4,776.00	$ 14,909.60
	$ 459.00	$ 5,146.00	UNKNOWN
editures (aw in effect)			$114,009.16

EXHIBIT B.11

U.S. COAST GUARD SPILL INVESTIGATION DATA
FROM PS/MEP ACTIVITIES REPORTS-13th CG DISTRICT [refs.67]

QTR/YR	UNIT	NO.	MAN HOURS	VEHICLE HOURS	BOAT HOURS
2/74	Portland	139	539	244	6
	Seattle	282	1057	350	-
	Astoria	33	208	102	2
	Port Angeles	9	26	8	5
	Coos Bay	11	53	10	9
	Grays Harbor (1)	9	98	65	2
	Totals	483	1981	779	24
1/74	Portland	77	470	245	4
	Seattle	229	1173	302	-
	Astoria	24	204	85	2
	Port Angeles	15	49	16	7
	Coos Bay	30	47	111	8
	Total	375	1944	759	21
4/73	Portland	103	367	213	6
	Seattle	242	998	148	67
	Astoria	32	175	86	4
	Port Angeles	3	9	7	2
	Coos Bay	28	257	110	-
	Total	408	1806	564	79
AVE	Portland	106	459	234	5
	Seattle	234	1076	267	22
	Astoria	30	196	91	3
	Port Angeles	9	28	7	5
	Coos Bay	23	119	77	6
	Grays Harbor	9	98	65	2
	Average Total	411	1976	741	43

[1]Figures for Grays Harbor were included in Astoria totals prior to this quarter. For averages, the figures were assumed to be constant for all three quarters.

EXHIBIT B.12.

U.S. COAST GUARD SPILL INVESTIGATION DATA

FROM PS/MEP ACTIVITIES REPORTS-11th AND 12th CG DISTRICTS [refs.67]

QTR/YR	UNIT	NO.	MAN HOURS	VEHICLE HOURS	BOAT HOURS
2/74	Concord	41	1113	443	-
	San Francisco	102	274	152	23
	Monterey	6	17	5	-
	Los Angeles/ Long Beach	189	3641*	741	40
	San Diego	97	194	50	22
	Santa Barbara	14	64	7	2
	Total	456	5368	1416	97
1/74	Concord	35	203	100	-
	San Francisco	165	432	266	46
	Monterey	8	60	14	-
	Humboldt Bay	14	74	36	7
	Los Angeles/ Long Beach	231	3460*	830	47
	San Diego	82	161	44	30
	Santa Barbara	20	112	27	2
	Total	555	4502	1317	112
4/73	Concord	57	697	310	-
	San Francisco	163	912	437	111
	Monterey	5	9	5	-
	Humboldt Bay	11	86	23	9
	Los Angeles/ Long Beach	197	3800*	455	5
	San Diego	50	152	19	19
	Santa Barbara	19	63	20	-
	Total	502	5720	1259	144
AVE	Concord	44	671	284	-
	San Francisco	143	539	285	60
	Monterey	6	20	8	-
	Humboldt Bay	11	75	26	14
	Los Angeles/ Long Beach	206	3632*	672	24
	San Diego	76	169	38	24
	Santa Barbara	18	80	18	1
	Average totals	504	5197	1331	124

*Man hour figures from Los Angeles/Long Beach include hours of standby time for investigation personnel.

EXHIBIT B.13.

SPILL REMOVAL DATA FOR SPILLS CLEANED UP IN WHICH U.S. COAST GUARD PERSONNEL PARTICIPATED-FROM PS/MEP ACTIVITIES REPORTS FOR 13th CG DISTRICT UNITS [refs.67]

QTR/YR	UNIT	NO.	MAN HOURS	VEHICLE HOURS	BOAT HOURS
2/74	Portland	-	-	-	-
	Seattle	3	65	16	-
	Astoria	2	29	-	2
	Port Angeles	-	-	-	-
	Coos Bay	-	-	-	-
	Grays Harbor	2	25	5	2
	Total	7	119	27	4
1/74	Portland	4	117	10	-
	Seattle	6	279	80	-
	Astoria	1	15	7	2
	Port Angeles	-	-	-	-
	Coos Bay	-	-	-	-
	Grays Harbor	-	-	-	-
	Total	11	411	97	2
4/73	Portland	8	186	20	-
	Seattle	1	25	8	-
	Astoria	-	-	-	-
	Port Angeles	-	-	-	-
	Coos Bay	-	-	-	-
	Grays Harbor	-	-	-	-
	Total	9	211	28	-
AVE	Portland	4	101	10	-
	Seattle	3	123	35	-
	Astoria	1	15	4	-
	Port Angeles	-	-	-	-
	Coos Bay	-	-	-	-
	Grays Harbor	-	-	-	1
	Average Total	9	247	51	1

EXHIBIT B.14.

SPILL REMOVAL DATA FOR SPILLS CLEANED UP IN WHICH CG PERSONNEL PARTICIPATED-FROM PS/MEP ACTIVITIES REPORTS FOR 11th AND 12th CG DISTRICT UNITS [ref.67]

QTR/YR	UNIT	NO.	MAN HOURS	VEHICLE HOURS	BOAT HOURS
2/74	Concord	1	140	42	-
	San Francisco	-	-	-	-
	Monterey	-	-	-	-
	Humboldt Bay	-	-	-	-
	Los Angeles/ Long Beach	3	26	12	3
	San Diego	-	-	-	-
	Santa Barbara	-	-	-	-
	Total	4	166	54	3
1/74	Concord	-	-	-	-
	San Francisco	-	-	-	-
	Monterey	1	1152	400	-
	Humboldt Bay	1	20	5	-
	Los Angeles/ Long Beach	2	20	10	-
	San Diego	-	-	-	-
	Santa Barbara	-	-	-	-
	Total	4	1192	415	-
4/73	Concord	-	-	-	-
	San Francisco	-	-	-	-
	Monterey	-	-	-	-
	Humboldt Bay	2	183	58	7
	Los Angeles/ Long Beach	3	347	41	-
	San Diego	-	-	-	-
	Santa Barbara	-	-	-	-
	Total	5	530	99	7
AVE	Concord	1/3	47	14	-
	San Francisco	-	-	-	-
	Monterey	1/3	384	133	-
	Humboldt Bay	1	68	21	2
	Los Angeles/ Long Beach	3	131	21	1
	San Diego	-	-	-	-
	Santa Barbara	-	-	-	-
	Average total	4 2/3	630	189	3

EXHIBIT B.15.

ADMINSTRATIVE/SUPPORT/TRAINING MAN-HOURS FROM PS/MEP ACTIVITIES REPORTS FROM WEST COAST COAST GUARD UNITS-AVERAGE FOR THREE QUARTERS OF FY 74 * [refs.67]

UNIT	ADMIN HRS	SUPPORT HRS	TRAINING HRS
Seattle	2000	446	548
Port Angeles	45	-	125
Grays Harbor	24	5	16
Portland	1227	703	95
Astoria	210	60	99
Coos Bay	unavail	unavail	unavail
Concord	436	1327	225
San Francisco	1195	1050	167
Monterey	83	7	13
Humboldt Bay	170	unavail	67
Los Angeles/Long Beach	1048	2135	161
San Diego	661	165	129
Santa Barbara	105	2117	3

*Some reports did not separate Port Safety from MEP hours. The ratio of personnel assigned to each function was used to obtain MEP hours when other sources did not provide the information.

EXHIBIT B.16

AVERAGE QUARTERLY MAN-HOURS SPENT ON MEP ACTIVITIES AT U.S. COAST GUARD UNITS DURING FISCAL YEAR 1974

UNIT	#	ADMIN	SUPPORT	TRAIN	INVEST	TOTAL
Seattle	8.0	2000	446	548	1076	4070
Port Angeles	.5	45	-	125	28	198
Astoria	1.0	210	60	99	196	565
Portland	4.5	1227	703	95	459	2484
Coos Bay	n.a.	unk.	unk.	unk.	119	unk.
Humboldt	n.a.	170	unk.	67	75	unk.
Concord	5.0	436	1327	225	671	2659
San Fran	5.5	1195	1050	167	539	2951
Monterey	.5	83	7	13	29	132
Santa Barbara	n.a.	105	unk.	3	80	unk.
LA/LB	n.a.	1048	2135	161	3634*	6978
San Diego	2.5	661	165	129	169	1124

#This is the quivalent number of personnel required based on a 520 hour quarter.

*This figure and the unknown figures were formulated under different assumptions than the figures for other units and cannot be compared directly with those other figures.

EXHIBIT B.17.

SUMMARY OF U.S. COAST GUARD PERSONNEL
ASSIGNED TO MEP BILLETS IN 1974 FROM
PS/MEP ACTIVITIES REPORTS *

UNIT	OFFICERS	ENLISTED	CIVILIANS
13th District Office	3	1	-
Seattle	2	4	-
Port Angeles	-	-	-
Grays Harbor	-	-	-
Portland	1.5	5.5	.5
Astoria	-	-	-
Coos Bay	-	-	-
12th District Office	3	1	-
San Francisco	4	7.5	-
Concord	1	6	-
Monterey	1	2	-
Humboldt Bay	-	-	-
11th District Office	3	1	-
Los Angeles/Long Beach	2	13	-
San Diego	1	4	-
Santa Barbara	-	2	-
Totals	21.5	47	.5

*These figures do not include personnel assigned as Commanding Officer or Executive Officer of any unit. National Strike Force personnel are also not included.

EXHIBIT B.18.

SELECTED SPILLS CLEANUP DATA
FROM LOCAL CAPTAIN OF THE PORT
RECORDS OF COAST GUARD FUNDED CLEANUPS

SPILL SIZE GALLONS	CONTRACTOR LABOR HRS	CONTRACTOR LABOR COST	CONTRACTOR EQUIP COST
800	384	$ 4706	$ 6554
5000	1360	29076	17148
50	46	655	1671
1000	130	2615	5731
175	35	1300	1879
300	365	4535	4538
200	55	720	1935
500	468	8420	5266
50	63	990	1459
UNK	12	139	798
UNK	10	143	447
40	49	625	2130
UNK	42	500	403
500	105	1752	4170
20	24	285	250
100	15	203	1277
100	15	212	766
200	40	678	1923
830	288	4150	3850
150	125	1600	2457
	$ 3628	$ 63294	

Average cost per labor hour $17.45

EXHIBIT B.19.

COST INFORMATION USED IN BATTLELE
STUDY FOR SELECTED CLEANUP RESOURCES [ref.29]

1. Personnel hourly rate (based on 8 hr day, includes ovhd and fringe benefits)	$10/man-hour
2. Containment booms (based on 3000 ft length - considered max. length deployable and maneuverable, deployment cost, including set up, positioning, recovery and cleanup are estimated at 16 months, 4 hrs intermediate boat time, $40 of misc. materials. Total cost per incident is $320. Useful boom life 2 years.)	$20/ft or $60,000/ system
3. Disposal (cost of transporting, transferring and cleanup of transfer vessels)	$.50/gallon
4. Auxiliary surface craft - intermediate large (intermediate craft up to 30 ft length, large craft 40 to 80 ft length)	$30/hr (w/crew) $40/hr (w/crew)
5. Sorbents - Commercial bulk material Polymer foams Straw (costs based on absorption capability with procurement costs $100 to $250 per ton, $1000 per ton and $30 per ton respectively)	$.30/gal. $.10/gal. $.03/gal.
6. Gelling agents (cost $3 per gallon of agent, administered on a 1-1 basis to oil)	$3.00/gal.
7. Equipment expected maintenace costs: 10% acquisition cost/year mechanical equipment 5% acquisition cost/year for booms	
8. Pumps and spray equipment: (maint. cost/yr $860, storage cost/yr $550)	$8,600/5 years
9. Advancing skimmer (maint. costs/yr $5000, storage costs/yr $550, capacity of 2000 gal/day)	$50,000/ 4 years
10. Conveyer (maint. costs/yr $5000, storage costs/yr $550)	$50,000/4 years

11. Endless belt on water surface (can be barge mounted, barge costs $20/hr, capacity 40 gallons per minute, maint. cost/yr $750, storage costs $600/yr) — $7,500/3 years

12. Suction device for use w/sorbents (incl. spreader, storage and decanting tanks, maint. costs $4,600/yr, storage costs $500/yr) — $16,000/4 years

EXHIBIT B.20

LABOR HOURS FOR RESPONSE TO
VARIOUS POLLUTION INCIDENT SIZES AS
USED IN THE BATTELLE-NORTHWEST STUDY [ref.29]

SPILL RESPONSE METHOD	2700 GAL SPILL	270,000 GAL SPILL	6,750,000 GAL SPILL
1. Pumps and spray equipment	8	32	1200
2. Advancing skimmer	15	700	14000
3. Gellants/conveyor	25	732	15200
4. Sorbents/conveyor	35	800	17000
5. Endless belt on water surface	16	300	6000
6. Sorbents/suction device	35	800	17000

The following pages are tables of the statistical properties of ten variables pertinent to analyses of MEP activities. Presented first is a summary of overall properties. The observations (24) represent 3 quarters of data for each of 8 areas. The three quarters are 4th quarter, 1973, and 1st and 2nd quarters, 1974. The areas are the Coast Guard jurisdictions for the Captain of the Port or Port Safety Offices in Seattle, Portland, Concord, San Francisco, Monterey, Humboldt Bay, Los Angeles/Long Beach, and San Diego.

The ten variables addressed are as follows:

1. Millions of barrels of petroleum transferred.
2. Tank vessel transits.
3. Petroleum handling waterfront facilities.
4. Number of cleanups in which Coast Guard personnel participated.
5. Coast Guard man-hours used in those cleanups.
6. Number of spills reported.
7. Volume of oil spilled.
8. Coast Guard man-hours used in spill investigations.
9. Coast Guard man-hours used in MEP administrative activities.
10. Coast Guard man-hours used in MEP support activities.

EXHIBIT B.21

STATISTICAL PROPERTIES OF 10 VARIABLES
ANALYZED FOR ALL 8 WEST COAST AREAS

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 1:

MEAN	28.587
STANDARD DEVIATION	32.949
MEDIAN	15.750
MINIMUM VALUE	0.300
MAXIMUM VALUE	195.000
RANGE	104.700

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 2:

MEAN	1051.250
STANDARD DEVIATION	905.600
MEDIAN	1028.500
MINIMUM BALUE	50.000
MAXIMUM VALUE	2233.000
RANGE	2183.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 3:

MEAN	37.125
STANDARD DEVIATION	30.416
MEDIAN	31.500
MINIMUM BALUE	6.000
MAXIMUM VALUE	98.000
RANGE	92.00

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 4:

MEAN	1.667
STANDARD DEVIATION	2.220
MEDIAN	1.000
MINIMUM VALUE	0.0
MAXIMUM VALUE	8.000
RANGE	8.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 5:

MEAN	110.625
STANDARD DEVIATION	242.245
MEDIAN	20.000
MINIMUM VALUE	0.0
MAXIMUM VALUE	1152.000
RANGE	1152.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 6;

MEAN	114.583
STANDARD DEVIATION	91.833
MEDIAN	5.000
MINIMUM VALUE	291.000
MAXIMUM VALUE	286.000
RANGE	

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 7:

MEAN	451.000
STANDARD DEVIATION	532.292
MEDIAN	199.500
MINIMUM VALUE	5.000
MAXIMUM VALUE	2000.000
RANGE	1995.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 8:

MEAN	829.042
STANDARD DEVIATION	1143.365
MEDIAN	375.000
MINIMUM VALUE	9.000
MAXIMUM VALUE	3800.000
RANGE	3791.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 9:

MEAN	901.417
STANDARD DEVIATION	819.777
MEDIAN	819.500
MINIMUM VALUE	100.000
MAXIMUM VALUE	4038.000
RANGE	3938.000

PROPERTIES OF THE 24 OBSERVATIONS OF VARIABLE 10:

MEAN	779.542
STANDARD DEVIATION	737.801
MEDIAN	756.500
MINIMUM VALUE	0.0
MAXIMUM VALUE	2160.000
RANGE	2160.000

EXHIBIT B.22.

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE CONCORD AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	34.867
STANDARD DEVIATION	4.332
MEDIAN	26.300
MINIMUM VALUE	30.000
MAXIMUM VALUE	38.300
RANGE	8,300

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	546.000
STANDARD DEVIATION	0.0
MEDIAN	546.000
MINIMUM VALUE	546.000
MAXIMUM VALUE	546.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	26.000
STANDARD DEVIATION	0.0
MEDIAN	26.000
MINIMUM VALUE	26.000
MAXIMUM VALUE	26.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	0.333
STANDARD DEVIATION	0.577
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	1.000
RANGE	1.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	46.667
STANDARD DEVIATION	80.829
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	140.000
RANGE	140.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	44.333
STANDARD DEVIATION	11.372
MEDIAN	41.000
MINIMUM VALUE	35.000
MAXIMUM VALUE	57.000
RANGE	22.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	77.667
STANDARD DEVIATION	107.375
MEDIAN	27.000
MINIMUM VALUE	5.000
MAXIMUM VALUE	201.000
RANGE	196.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	671.000
STANDARD DEVIATION	455.557
MEDIAN	697.000
MINIMUM VALUE	293.000
MAXIMUM VALUE	1113.000
RANGE	910.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	421.333
STANDARD DEVIATION	50.897
MEDIAN	392.000
MINIMUM VALUE	392.000
MAXIMUM VALUE	480.000
RANGE	88.000

PROPERTIES OF THE 3 OBSERVATION OF VARIABLE 10:

MEAN	1595.667
STANDARD DEVIATION	17.898
MEDIAN	1606.000
MINIMUM VALUE	1575.000
MAXIMUM VALUE	1696.000
RANGE	31.000

EXHIBIT B.23.

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE LOS ANGELES/LONG BEACH AREA

PROPERTIES OF THE 3 OBSERVATIONS OF THE VARIABLE 1:

MEAN	103.067
STANDARD DEVIATION	1.721
MEDIAN	102.500
MINIMUM VALUE	101.700
MAXIMUM VALUE	105.000
RANGE	3.300

PROPERTIES OF THE 3 OBSERVATIONS OF THE VARIABLE 2:

MEAN	2233.000
STANDARD DEVIATION	0.0
MEDIAN	2233.000
MINIMUM VALUE	2233.000
MAXIMUM VALUE	2233.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF THE VARIABLE 3:

MEAN	39.000
STANDARD DEVIATION	0.0
MEDIAN	39.000
MINIMUM VALUE	39.000
MAXIMUM VALUE	39.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF THE VARIABLE 4:

MEAN	2.667
STANDARD DEVIATION	0.577
MEDIAN	3.000
MINIMUM VALUE	2.000
MAXIMUM VALUE	3.000
RANGE	1.000

PROPERTIES OF THE 3 OBSERVATIONS OF THE VARIABLE 5:

MEAN	131.000
STANDARD DEVIATION	187.086
MEDIAN	26.000
MINIMUM VALUE	20.000
MAXIMUM VALUE	347.000
RANGE	327.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	205.667
STANDARD DEVIATION	22.30;
MEDIAN	197.000
MINIMUM VALUE	189.000
MAXIMUM VALUE	231.000
RANGE	42.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	868.000
STANDARD DEVIATION	230.918
MEDIAN	985.000
MINIMUM VALUE	602.000
MAXIMUM VALUE	1017.000
RANGE	415.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	3633.667
STANDARD DEVIATION	170.119
MEDIAN	3641.000
MINIMUM VALUE	3460.000
MAXIMUM VALUE	3800.000
RANGE	340.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	1128.333
STANDARD DEVIATION	20.207
MEDIAN	1140.000
MINIMUM VALUE	1105.000
MAXIMUM VALUE	1140.000
RANGE	35.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	2080.000
STANDARD DEVIATION	69.282
MEDIAN	2040.000
MINIMUM VALUE	2040.000
MAXIMUM VALUE	2160.000
RANGE	120.000

EXHIBIT B.24.

STATISTICAL PROPERTIES OF THE 10 VARIABLES FOR THE SEATTLE AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	35.667
STANDARD DEVIATION	22.404
MEDIAN	25.100
MINIMUM VALUE	20.500
MAXIMUM VALUE	61.400
RANGE	40.900

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	2098.000
STANDARD DEVIATION	0.0
MEDIAN	2098.000
MINIMUM VALUE	2098.000
MAXIMUM VALUE	2098.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	98.000
STANDARD DEVIATION	0.0
MEDIAN	98.000
MINIMUM VALUE	98.000
MAXIMUM VALUE	98.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	3.333
STANDARD DEVIATION	2.517
MEDIAN	3.000
MINIMUM VALUE	1.000
MAXIMUM VALUE	6.000
RANGE	5.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	123.000
STANDARD DEVIATION	136.572
MEDIAN	65.000
MINIMUM VALUE	25.000
MAXIMUM VALUE	279.000
RANGE	254.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	260.000
STANDARD DEVIATION	36.851
MEDIAN	245.000
MINIMUM VALUE	244.000
MAXIMUM VALUE	291.000
RANGE	47.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	999.333
STANDARD DEVIATION	287.340
MEDIAN	1007.000
MINIMUM VALUE	318.000
MAXIMUM VALUE	1083.000
RANGE	765.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	802.667
STANDARD DEVIATION	421.450
MEDIAN	1007.000
MINIMUM VALUE	318.000
MAXIMUM VALUE	1083.000
RANGE	765.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	2045.333
STANDARD DEVIATION	1726.924
MEDIAN	1114.000
MINIMUM VALUE	984.000
MAXIMUM VALUE	4038.000
RANGE	3054.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	446.000
STANDARD DEVIATION	353.083
MEDIAN	397.000
MINIMUM VALUE	221.000
MAXIMUM VALUE	720.000
RANGE	499.000

EXHIBIT B.25.

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE SAN FRANCISCO AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	35.000
STANDARD DEVIATION	0.0
MEDIAN	35.000
MINIMUM VALUE	35.000
MAXIMUM VALUE	35.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	1411.000
STANDARD DEVAITION	0.0
MEDIAN	1511.000
MINIMUM VALUE	1511.000
MAXIMUM VALUE	1511.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	37.000
STANDARD DEVIATION	0.0
MEDIAN	37.000
MINIMUM VALUE	37.000
MAXIMUM VALUE	37.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	0.0
STANDARD DEVIATION	0.0
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	0.0
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	0.0
STANDARD DEVIATION	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	0.0
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	143.333
STANDARD DEVIATION	35.810
MEDIAN	163.000
MINIMUM VALUE	102.000
MAXIMUM VALUE	165.000
RANGE	63.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	100.333
STANDARD DEVIATION	88.636
MEDIAN	78.000
MINIMUM VALUE	35.000
MAXIMUM VALUE	198.000
RANGE	173.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	539.333
STANDARD DEVIATION	332.267
MEDIAN	432.000
MINIMUM VALUE	374.000
MAXIMUM VALUE	912.000
RANGE	638.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	1200.000
STANDARD DEVIATION	173.205
MEDIAN	1300.000
MINIMUM VALUE	1000.000
MAXIMUM VALUE	1300.000
RANGE	300.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	1066.667
STANDARD DEVIATION	57.735
MEDIAN	1100.000
MINIMUM VALUE	1000.000
MAXIMUM VALUE	1100.000
RANGE	100.000

EXHIBIT B.26

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE MONTEREY AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	8.800
STANDARD DEVIATION	3.470
MEDIAN	10.600
MINIMUM VALUE	4.800
MAXIMUM VALUE	11.000
RANGE	6.200

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	112.000
STANDARD DEVIATION	0.0
MEDIAN	112.000
MINIMUM VALUE	112.000
MAXIMUM VALUE	112.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	8.000
STANDARD DEVIATION	0.0
MEDIAN	8.000
MINIMUM VALUE	8.000
MAXIMUM VALUE	8.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	0.333
STANDARD DEVIATION	0.577
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	1.000
RANGE	1.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	384.000
STANDARD DEVIATION	665.108
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	1152.000
RANGE	1152.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	6.333
STANDARD DEVIATION	1.528
MEDIAN	6.000
MINIMUM VALUE	5.000
MAXIMUM VALUE	8.000
RANGE	3.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	672.667
STANDARD DEVIATION	1149.511
MEDIAN	13.000
MINIMUM VALUE	5.000
MAXIMUM VALUE	2000.000
RANGE	1995.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	28.667
STANDARD DEVIATION	27.429
MEDIAN	17.000
MINIMUM VALUE	9.000
MAXIMUM VALUE	60.000
RANGE	51.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	106.667
STANDARD DEVIATION	11.547
MEDIAN	100.000
MINIMUM VALUE	100.000
MAXIMUM VALUE	120.000
RANGE	20.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	6.667
STANDARD DEVIATION	11.547
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	20.000
RANGE	20.000

EXHIBIT B.27

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE HUMBOLDT BAY AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	0.633
STANDARD DEVIATION	0.306
MEDIAN	0.700
MINIMUM VALUE	0.300
MAXIMUM VALUE	0.900
RANGE	0.600

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	89.000
STANDARD DEVIATION	0.0
MEDIAN	89.000
MINIMUM VALUE	89.000
MAXIMUM VALUE	89.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	6.000
STANDARD DEVIATION	0.0
MEDIAN	6.000
MINIMUM VALUE	6.000
MAXIMUM VALUE	6.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	1.000
STANDARD DEVIATION	1.000
MEDIAN	1.000
MINIMUM VALUE	0.0
MAXIMUM VALUE	2.000
RANGE	2.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	67.667
STANDARD DEVIATION	100.281
MEDIAN	20.000
MINIMUM VALUE	0.0
MAXIMUM VALUE	183.000
RANGE	183.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	10.667
STANDARD DEVIATION	3.512
MEDIAN	11.000
MINIMUM VALUE	7.000
MAXIMUM VALUE	14.000
RANGE	7.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	18.333
STANDARD DEVIATION	13.013
MEDIAN	19.000
MINIMUM VALUE	5.000
MAXIMUM VALUE	31.000
RANGE	36.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	75.333
STANDARD DEVIATION	11.060
MEDIAN	74.000
MINIMUM VALUE	65.000
MAXIMUM VALUE	87.000
RANGE	22.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	223.667
STANDARD DEVIATION	30.022
MEDIAN	241.000
MINIMUM VALUE	189.000
MAXIMUM VALUE	241.000
RANGE	52.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	16.667
STANDARD DEVIATION	28.868
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	50.000
RANGE	50.000

EXHIBIT B.28

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE SAN DIEGO AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	1.3000
STANDARD DEVIATION	0.436
MEDIAN	1.100
MINIMUM VALUE	1.000
MAXIMUM VALUE	1.800
RANGE	0.800

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	50.000
STANDARD DEVIATION	0.0
MEDIAN	50.000
MINIMUM VALUE	50.000
MAXIMUM VALUE	50.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	15.000
STANDARD DEVIATION	0.0
MEDIAN	15.000
MINIMUM VALUE	15.000
MAXIMUM VALUE	15.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	0.0
STANDARD DEVIATION	0.0
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	0.0
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 5:

MEAN	0.0
STANDARD DEVIATION	0.0
MEDIAN	0.0
MINIMUM VALUE	0.0
MAXIMUM VALUE	0.0
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	76.333
STANDARD DEVIATION	24.997
MEDIAN	82.000
MINIMUM VALUE	50.000
MAXIMUM VALUE	97.000
RANGE	47.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	293.333
STANDARD DEVIATION	229.716
MEDIAN	334.000
MINIMUM VALUE	46.000
MAXIMUM VALUE	500.000
RANGE	454.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	169.000
STANDARD DEVIATION	22.112
MEDIAN	161.000
MINIMUM VALUE	152.000
MAXIMUM VALUE	194.000
RANGE	42.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	640.667
STANDARD DEVIATION	24.826
MEDIAN	655.000
MINIMUM VALUE	612.000
MAXIMUM VALUE	655.000
RANGE	43.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	163.333
STANDARD DEVIATION	20.207
MEDIAN	175.000
MINIMUM VALUE	140.000
MAXIMUM VALUE	175.000
RANGE	35.000

EXHIBIT B.29.

STATISTICAL PROPERTIES OF THE 10 VARIABLES
FOR THE PORTLAND AREA

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 1:

MEAN	9.367
STANDARD DEVIATION	1.301
MEDIAN	9.300
MINIMUM VALUE	8.100
MAXIMUM VALUE	10.700
RANGE	2.600

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 2:

MEAN	1771.000
STANDARD DEVIATION	0.0
MEDIAN	1771.000
MINIMUM VALUE	1771.000
MAXIMUM VALUE	1771.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 3:

MEAN	68.000
STANDARD DEVIATION	0.0
MEDIAN	68.000
MINIMUM VALUE	68.000
MAXIMUM VALUE	68.000
RANGE	0.0

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 4:

MEAN	5.667
STANDARD DEVIATION	2.982
MEDIAN	5.000
MINIMUM VALUE	4.000
MAXIMUM VALUE	8.000
RANGE	4.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIBLE 5:

MEAN	132.667
STANDARD DEVIATION	53.003
MEDIAN	132.000
MINIMUM VALUE	80.000
MAXIMUM VALUE	186.000
RANGE	106.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 6:

MEAN	140.000
STANDARD DEVIATION	19.468
MEDIAN	163.000
MINIMUM VALUE	155.000
MAXIMUM VALUE	192.000
RANGE	37.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 7:

MEAN	582.333
STANDARD DEVIATION	453.588
MEDIAN	572.000
MINIMUM VALUE	134.000
MAXIMUM VALUE	1941.000
RANGE	907.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 8:

MEAN	712.667
STANDARD DEVIATION	240.421
MEDIAN	799.000
MINIMUM VALUE	441.000
MAXIMUM VALUE	898.000
RANGE	457.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 9:

MEAN	1445.333
STANDARD DEVIATION	98.855
MEDIAN	1410.000
MINIMUM VALUE	1369.000
MAXIMUM VALUE	1557.000
RANGE	188.000

PROPERTIES OF THE 3 OBSERVATIONS OF VARIABLE 10:

MEAN	861.333
STANDARD DEVIATION	105.633
MEDIAN	808.000
MINIMUM VALUE	793.000
MAXIMUM VALUE	983.000
RANGE	190.000

APPENDIX C

A HYPOTHETICAL MEP ORGANIZATION FOR THE STATE OF WASHINGTON

This appendix presents a hypothetical organization to perform the MEP functions of investigation and cleanup. The organization was designed to respond to the amount, sizes, and locations of spills occurring in the State of Washington in fiscal year 1974. It was formulated in accordance with the assumptions listed in the text of this study.

The list of costs was derived and priced by the following procedures:

1. Equipment inventories of various Coast Guard units with Marine Environmental Protection responsibilities were reviewed. Those include Captain of the Port offices and the Strike Teams of the National Strike Force.

2. Equipment inventories and price lists of commercial firms who perform pollution cleanup functions were reviewed. These provided prices for some of the equipment, booms, sorbents, disposal tanks, pumps, power units, and personnel pay scales.

3. Estimates of necessary equipment and prices were given in conversations with various Coast Guard personnel employed in MEP billets.

4. General Telephone Co. provided information on the costs of radiotelephone communication equipment.

5. .The General Services Administration provided information on vehicles and building expenses.

6. Newspaper advertisements were used to insure that the prices listed were within the range of prices in the open market.

7. Federal supply schedules gave operation details and prices of some equipment.

8. Coast Guard contracts for spill cleanup provided samples of equipment being used and the prices thereof.

9. Census of Governments contains salary schedules for State employees.

10. Commandant Notice 7100, "Annual Standard Personnel Costs; furnishing of," lists Coast Guard personnel costs. These were used for comparison.

11. The Battelle Study, mentioned previously, provided information on costs, equipment lists, operating and maintenance costs, equipment life expectancies and performance characteristics. Operating and maintenance costs, and equipment lives used therein are those for equipment used in the Chemical and Petroleum industries.

EXHIBIT C.1.

HYPOTHETICAL WASHINGTON ORGANIZATION

Operating Units

AREA	INVESTIGATION TEAM	CLEANUP TEAM	#PERSONNEL
1. N. Puget Sound	Yes	Yes	6
2. S. Puget Sound	Yes	Yes	6
3. Port Angeles	Yes		2
4. Longview/Kalama	Yes		2
5. Kennewick/Pasco	Yes	1/2	4
6. Grays Harbor	Yes		2
			22

Administrative Staff

FUNCTION	#PERSONNEL
1. Review, liaison, filing, coordination	3
2. Controller, contractor, supply	3
3. Training, relief	3
	9

Stockpiling sites without personnel

1. Upper Columbia River

EXHIBIT C.2

ORGANIZATION CHART OF HYPOTHETICAL STATE ORGANIZATION

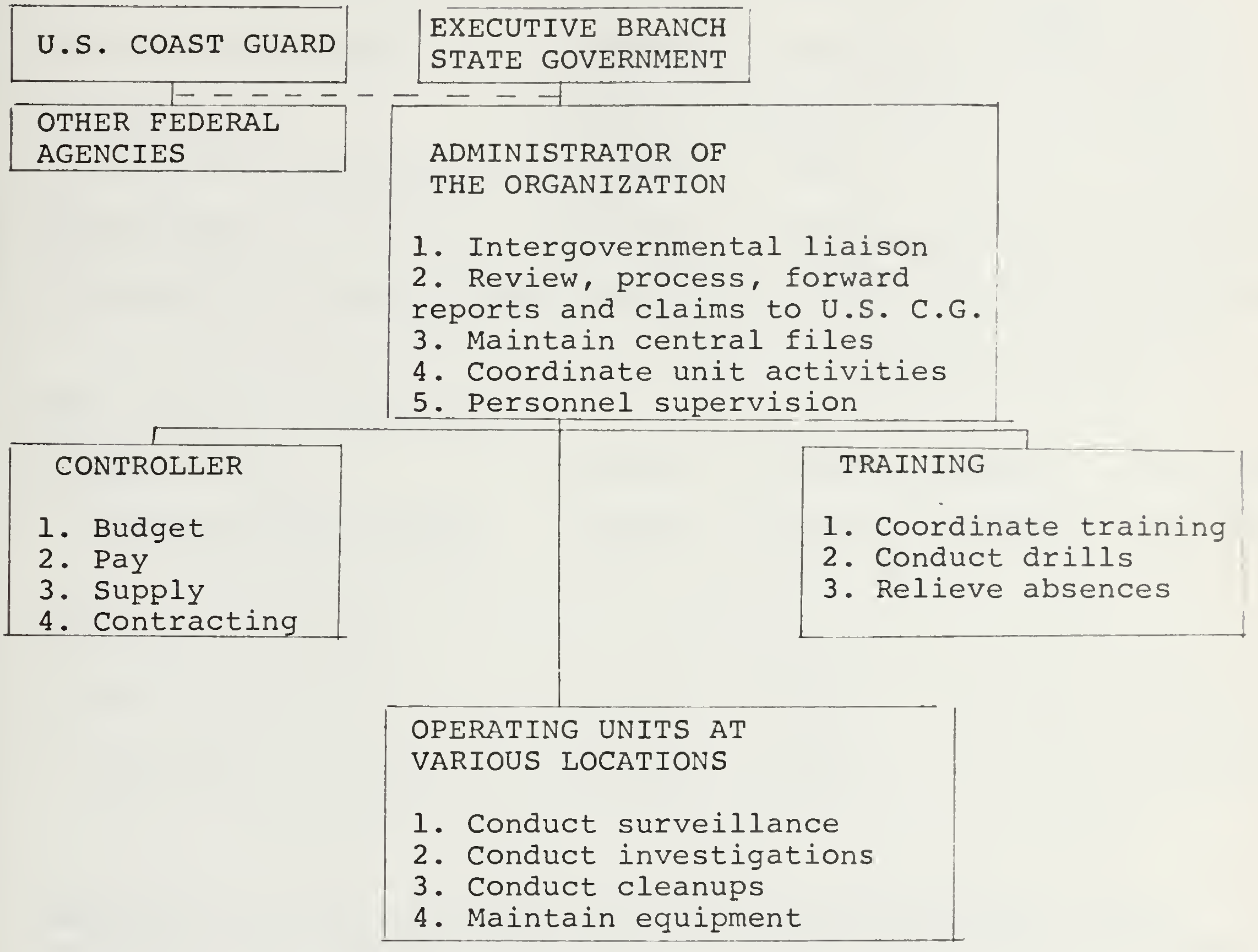

EXHIBIT C.3.

HYPOTHETICAL PERSONNEL PAY LEVELS

Administrative Staff	Base Pay	Emp. Exp	O.T. allowance	Total
Supervisor	$17,500	$2,400		$20,000
Operations Assistant	14,000	2,500		16,500
Controller	14,000	2,500		16,500
Secretaries, Supply Clerk	8,000	2,000		10,000
Operating Units personnel				
Supervisors	14,000	2,500	3,500	20,000
Investigators, Cleanup	12,000	2,500	3,000	17,500
Training personnel				
Supervisor	13,000	2,500		15,500
Assistant	12,000	2,500		14,500

Employer's expense includes F.I.C.A., Federal and State Unemployment tax, Pension and Health plans, and Workmen's Compensation.

EXHIBIT C.4.

COST OF CLEANUP EQUIPMENT
IN HYPOTHETICAL INVENTORY

		yearly maint.	years life	subsequent replacement annual cost
1. Communication Equipment				
Portable radio sets (6)	$2,000	$200	2	$1,000
Radiotelephones (2)	n.a.	3,600	n.a.	n.a.
2. Photographic and Recording Equipment				
Polaroid cameras (2)	300	200	2	150
35MM Reflex cameras (2)	500	200	2	250
Cassette Recorders (2)	250	50	2	125
3. Boats				
Inflatable w/ outboard	2,500	450	3	833
boat w/ trailer and motor	4,000	800	5	800
4. Booms				
1000 ft., portable w/ trailer	8,000	400	2	4,000
5. Spreading and Removal Equipment				
Pumps w/ power units (2)	4,000	400	5	800
Hose w/ spray equipment	1,000	100	4	250
Suction units or skimmers	1,200	120	4	300
6. Vehicles				
4-wheel drive carryalls (2)	10,000	2,500	3	3,333

		yearly maint.	years life	subsequent replacement annual cost
7. Sorbents				
50 lb bags (200)	1,100	n.a.	1/12	13,200
8. Portable tank-250 gals.	500	25	10	50
9. Ancillary Costs				
Hand tools	1,000	n.a.	1	1,000
Block and tackle	250	12.50	2	125
Bird Care gear	50	n.a.	1/2	100
Expendables	100	n.a.	1/2	1,200
Waste disposal drums	50	2.50	5	10
Fresh Air Equipment Packs	1,200	240	4	300
Lights	250	25	2	125
10. Personal equipment	1,500	300	2	750
Initial expense	$39,750		Total	$28,701
& op/maint.	11,225			
Total year 1	$50,975			

EXHIBIT C.5.

OTHER HYPOTHETICAL EXPENSES

ACCOMMODATION EXPENSE

1. Office, storage, garage space 2,500 sq. ft. @ $.20/mo.	$6,000
2. Office space w/ adjacent parking 200 sq. ft. @ $.50/mo.	$1,200
3. Office space 1,000 sq. ft. @ $.40/mo.	$4,800

TRAINING EXPENSE

1. 4 weeks per man	$1,000

ADDITIONAL TRAVEL EXPENSE

1. One out of immediate area per month, one air assistance per quarter, for two team members, for full teams.	$200/mo.

EXHIBIT C.6.

HYPOTHETICAL COSTS FOR OTHER NECESSARY EQUIPMENT

	initial cost	annual maint.	years approx. life	subsequent annual expense
Remote stockpile of cleanup equip.				
Boom	$8,000	$50	10	$800
Sorbent mat'l	2,750	n.a.	2	1,374
Disposal drums	250	10	10	25
Block and tackle	250	10	5	50
Totals	$11,250	$70		$2,250
Investigation team budget				
Portable radios	$1,000	$100	2	$500
Radiotelephones	n.a.	3,600	n.a.	n.a.
Polaroid cameras	300	200	2	150
35MM Reflex cameras	500	200	2	250
Cassette recorders	250	50	2	250
Sedans	6,000	2,100	3	2,000
Special clothing	500	150	2	250
Sampling equip.	400	n.a.	1	400
Totals	$8,950	$6,400		$3,675

EXHIBIT C.7.

TOTAL COST TO WASHINGTON

	Initial	annual personnel costs	annual ops & maint.	subsequent replacement annual expense
1. Cleanup personnel				
8 @ 17,500		$140,000		
2 @ 20,000		40,000		
2. Cleanup equip.	$110,625		$28,133	$74,003
3. Accommodations			12,500	
4. Travel		4,800		
Cleanup totals	$110,625	$184,800	$49,633	$74,003
5. Invest. personnel				
12 @ $17,500		210,000		
6. Equipment	53,700		38,400	22,050
7. Accommodations			6,100	
Invest. totals	$53,700	$210,000	$44,500	$22,050
8. Admin. personnel				
1 @ 20,000		20,000		
2 @ 16,500		33,000		
3 @ 10,000		30,000		
9. Accommodations			3,600	
Admin. totals		$83,000	$3,600	
10. Training personnel				
1 @ 15,500		15,500		
2 @ 14,500		29,000		
11. Accommodations			1,200	
12. Training		31,000		
Training totals		$75,000	$1,200	

TOTAL COST TO WASHINGTON-cont.

	Initial	annual personnel costs	annual ops and maint.	subsequent replacement annual expense
Totals	$164,325	$553,300	$89,933	$96,053
Initial expense		$897,558		
& 25% overhead		$201,890		
Total		$1,009,448		
Total w/inflation		$1,231,527		

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